Chatham House Report

Paola Subacchi, Stephen Pickford, Davide Tentori and Helena Huang

Building Growth in Europe

Innovative Financing for Infrastructure

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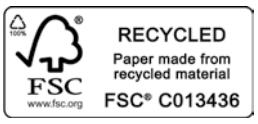

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Acronyms

ABS	Asset-Backed Security
AUM	Asset Under Management
BNDES	Brazilian Deveopment Bank
BRICS	Brazil, Russia, India, China, South Africa
CDC	Caisse des Dépôts et Consignations
CDO	Collateralized Debt Obligation
CDP	Cassa Depositi e Prestiti
CMBS	Commercial Mortgage-Backed Security
DiBOSS[tm]	Digital Building Operating System Solution[tm]
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECB	European Central Bank
EDA	European Debt Agency
EDP	Energias de Portugal
EIB	European Investment Bank
ELTIF	European Long-Term Investment Fund
FSB	Financial Stability Board
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
G20	Group of Twenty
HS2	High Speed Two
ICO	Instituto de Crédito Oficial
ICT	Information and Communication Technology
IPO	Initial Public Offering
KfW	Kreditanstalt für Wiederaufbau
NEET	Not in Employment, Education or Training
NIMBY	Not In My Back Yard
NIP	National Infrastructure Plan
NPV	Net Present Value
NSFR	Net Stable Funding Ratio
OECD	Organisation for Economic Co-operation and Development
OTPPB	Ontario Teachers' Pension Plan Board
PBCE	Project Bond Credit Enhancement
PBI	Project Bond Initiative
PFI	Private Finance Initiative
PKO	Polska Kasa Opieki
PPP	Public–Private Partnership
PSBP	Priority School Building Programme
R&D	Research and Development
RMBS	Residential Mortgage-Backed Security
S&P	Standard and Poor's
SPV	Special Purpose Vehicle
SWF	Sovereign Wealth Fund
TENs	Trans-European Networks
TFP	Total Factor Productivity
UAV	Unarmed Aerial Vehicle
WEF	World Economic Forum

Executive Summary and Recommendations

Europe needs economic growth. The global financial crisis has exacerbated structural weaknesses on the supply side, has made the constraints imposed by the single currency even more stringent for euro area countries, and has led to a chronic lack of demand. To unlock the potential for long-term growth and job creation, this report suggests that there needs to be more and better investment in infrastructure.

The infrastructure shortfall in Europe is huge, from power generation and distribution to transport networks. It has been estimated that countries need around €2 trillion more investment between 2013 and 2020 than currently planned. And this shortfall is due to grow over time – to a total of almost €15 trillion up to 2030 – in the face of population ageing, environmental changes and the need to replace existing infrastructure. The stock of infrastructure also needs to be revamped. In most of the major countries the proportion of output spent on infrastructure has been on a declining trend since the mid-1960s. The financial crisis further contributed to this decline. In the EU, overall investment dropped sharply after the start of the financial crisis, from 21.3% of GDP in 2007 to 17.3% in 2013.

Low interest rates currently make liquidity abundant and borrowing relatively cheap. There is now a unique opportunity to harness cheap funding and use it for long-term projects. At the same time institutional investors, such as pension funds, with total assets of approximately $75 trillion, are particularly interested in long-term investment with the potential to generate reliable multi-year revenues that would help them match their liabilities for pension payments.

An innovative approach to infrastructure projects, in terms both of policies and of financial instruments, has the potential to create a virtuous circle of stronger economic growth and job creation, improvements in productivity and enhanced financial stability. By updating existing infrastructure and investing in new, innovative projects, and by matching the duration of investment with its demographics, Europe has the opportunity to revive its economy and ward off the risk of 'secular stagnation'.

Large infrastructure projects in Europe generate positive spillovers on job creation and productivity growth that transcend national borders. They are *de facto* pan-European because they employ materials, technology, machineries and people from different countries. Europe also needs more of these projects that cut across borders, such as better-integrated energy networks.

Of course, large infrastructure projects have often in the past been characterized by waste, inefficiency and in some cases corruption. Europe is littered with too many examples of ill-conceived, badly implemented and over-spent infrastructure projects. Indeed one of the forces that contributed to the sovereign debt crisis was the misallocation of resources, notably in the south, towards excessive infrastructure investments, made possible by cheap financing. But bad past experience should not prevent Europe from finding new and better ways to finance and manage infrastructure investment in the future. Lessons need to be taken on board, and safeguards put in place to ensure that resources are directed towards projects with good returns.

Above all, the public sector should go back to taking a leading role on large infrastructure projects. Only the public sector can bear the ultimate risk involved in these projects. Innovative but complex projects such as the Channel Tunnel need an 'owner of last resort' that is prepared to recapitalize the project, if necessary, rather than letting it fail. Private investors do not have the time horizon or the financial capacity to step in, and their objectives are often not aligned with the public ones.

In addition, as described below, the EU and its member governments should pick up a part of the tab and help launch projects financed by jointly issued 'eurobonds'. The return on well-selected and well-managed infrastructure projects is certainly higher than the current low return on risk-free financial instruments in an environment of abundant liquidity and under-utilized resources. If economic actors, both public and private, can be encouraged to take advantage of current conditions – where finance is relatively cheap and real resources relatively plentiful – to increase investment in infrastructure, this can create a virtuous circle and kick-start growth.

Policy recommendations to boost infrastructure investment within available financial resources

1. Develop a pan-European infrastructure strategy to encourage 'good' infrastructure investment, address constraints and remove bottlenecks.

- Identify short-term and long-term priorities in a forward-looking approach. Countries should define priority projects, which focus on areas with a sustained impact on economic growth and the potential to enhance productivity.
- Improve the regulatory framework and provide better financial 'instruments' – assets, sources and vehicles – to encourage greater investment and make better use of the existing financial resources.
- Encourage the right choice of projects. In order to avoid inefficiencies and waste of financial resources, and to create a comprehensive pipeline at the EU

level, a better mechanism for project selection needs to be designed on the model of the UK's National Infrastructure Plan.

- Projects submitted by member states to the European Commission should be selected through a bottom-up approach and on the basis of criteria such as transnational dimension, size, sectors with high technological intensity and: priority should be given to sectors with high technological intensity, and economic return.

2. Create a European Infrastructure Agency to be responsible for the coordination and implementation of the pan-European infrastructure strategy. This agency should work in collaboration with the G20, the World Bank and the regional development banks as well as with the European Commission, the EIB and the EU member states to exchange information and best practice, set up a pan-European database of projects and assist investors to seek projects relevant to them and to compare them across different countries.

3. Foster effective collaboration between the public and the private sector. If Europe has the ambition to lead again on innovation and competitiveness, then a good 'mix' between public and private participation needs to be devised. For example:

- the public sector should play a key role at a project's initial stage: it should set priorities, provide a transparent procurement procedure, offer initial financial support, provide guarantees and smooth risks;

- public-private partnerships (PPPs) should be encouraged. A European PPP Expertise Centre should be created as a joint initiative by the European Investment Bank (EIB) and the European Commission to share experience and expertise, analysis and best practice relating to all aspects of PPPs. Procurement procedures should do better at specifying the costs and risks of projects in order to avoid delays and extra costs. There should also be more transparency on the returns made by equity investors;

- additional upfront guarantees from the public sector should provide support throughout their life-cycle for large projects with higher risks but high public benefits. When a project runs into difficulties, the public sector should step in and take ownership of the asset.

4. Promote a well-functioning market and implement policies that aim to match supply and demand of capital. These include:

- reviewing the rating criteria for investors, which currently favour financial assets with short-term maturities. For instance, speculative-grade short duration loans (rated 'BB+' and below) currently require less capital allocated by insurers than a four-year 'BBB+' or eight-year 'A+' project investment;

- facilitating access to long-term investment funds. The European Commission roadmap of March 2014 suggests new ways to unlock long-term financing to meet the needs of the European economy;

- fostering coordinated action by national governments. The political groups in the recently elected European Parliament should make this issue a priority on their agendas, communicating this also to MEPs' national capitals.

5. Improve the allocation of Structural and Cohesion Funds in order to tackle inefficiencies, leverage up the resources available and create incentives to choose the right projects by:

- providing EU funds only to projects included in the European pipeline in order to improve resource allocation;

- ensuring support, advice and due diligence so as to reduce inefficiencies;

- reducing the proportion of co-financing by making more European resources available. The European Commission could use Structural and Cohesion Funds to fund a small portion of the total costs, with the bulk of the financing covered by loans from the EIB and national development banks. These institutions could pool their available resources by issuing euro-denominated securities for investment in infrastructure projects;

- reducing political interference at the regional/local level in the definition and management of infrastructure policies through a due diligence process undertaken by the EIB, so as to assure investors about the strength and stability of the country-specific regulatory frameworks.

6. Promote the use of project bonds to fill financing gaps in the riskier stages of infrastructure projects undertaken by the private sector and included in the European pipeline. Resources available for the EU 2020 Project Bond Initiative, carried out by the EIB and currently in its pilot phase, should be increased. The Project Bond Initiative should be strengthened through:

- broadening the pipeline of suitable projects and focusing on bridging the gap between debt and equity

capital to help projects develop through their riskier stages. Resources could be pooled with national development banks, such as Cassa Depositi e Prestiti, Caisse des Dépôts et Consignations, Kreditanstalt für Wiederaufbau, Instituto de Credito Oficial, PKO Bank Polski;

- issuing European-backed bonds (or 'eurobonds') with long maturities for infrastructure projects. Since issuing Eurobonds fully backed by all EU member states is still a sensitive political issue, bonds could be jointly issued by national development banks together with the EIB. These hybrid bonds would be transnational and jointly guaranteed by participating national governments, making them more attractive to investors.

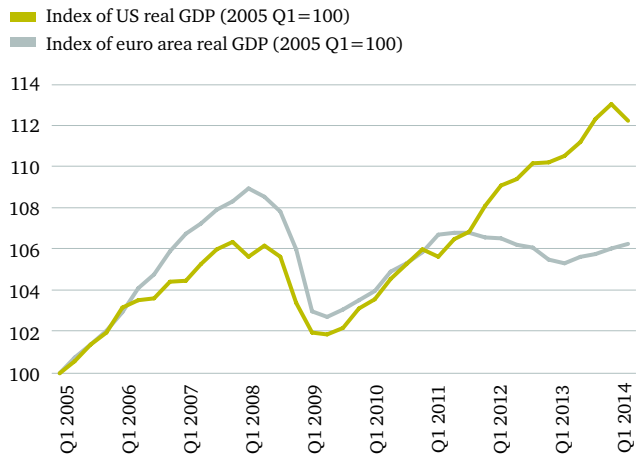
7. 'Bundle' smaller projects that cannot reach a dimensional threshold, such as social infrastructure projects, in an 'aggregator' – a pooling vehicle which can help obtain finance. The EU aggregator could be modelled on the UK experience, where the Priority School Building Programme is now financing renovation works of 215 schools with a funding requirement of £700 million.
8. Promote higher infrastructure investment in countries with wider fiscal space. Germany, for instance, requires investment to upgrade and modernize its infrastructure and has the necessary fiscal capacity to undertake more ambitious investment programmes.

1. Introduction

The European economy has proved to be much less resilient to the financial crisis than other economies. From 2008 to 2013, real gross domestic product (GDP) fell by 1.3% in the European Union and by 2.3% in the euro area. The contraction was much more severe in southern countries, with output falling over the last five years by 22% in Greece, 8% in Italy and 7% in both Spain and Portugal.

Unlike in the United States, for example, output has still not recovered to its pre-crisis level (Figure 1.1). Under-utilization of productive capacity is chronic, the risk of deflation is increasing and public support for the European project is weakening. Public action is urgently needed. But what action?

Figure 1.1: Comparison of real GDP between US and euro area

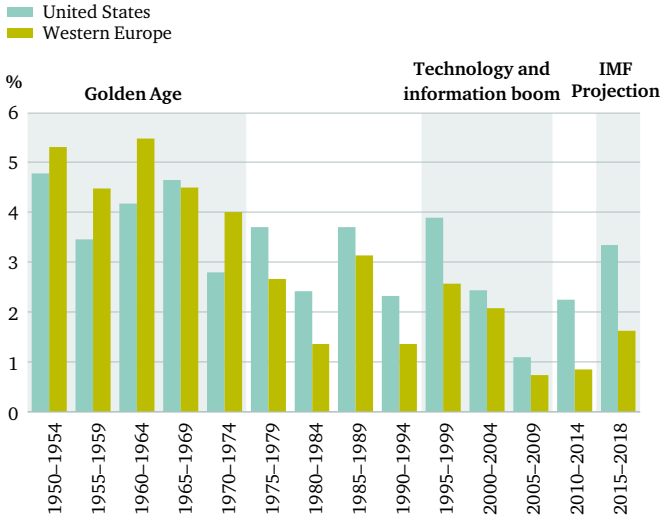


Source: Oxford Economics, 2014.

Policies need to focus on strong and sustainable growth to get out of the slump that Europe has experienced since the global financial crisis. But growth continues to be feeble in most European countries. Over the next five years, the EU economy is forecast to grow at the average annual rate of 1.8%, while that of the United States is expected to expand at 2.5% a year. Even Germany, which fared much better than other European economies through the crisis, has experienced a more subdued recovery than the United States. Germany's economy is projected to grow by 1.6% this year and at an average annual rate of 1.4% from 2015 to 2019. The United Kingdom is one of the few countries that can match the US performance. UK GDP is projected to grow by 2.4% in 2014, and by an average 2.4% over the next five years (IMF, 2014).

Europe's modest economic performance relative to the US predates the global financial crisis and goes back to the mid-1970s (Figure 1.2). The gap widened significantly in the 1990s, with US yearly GDP growth averaging over 1% more than that of Western Europe.[1] The crisis helped to narrow this gap for a short period, but it has widened again.

Figure 1.2: GDP growth rate in the past six decades, US vs. Western Europe



Source: Bolt and Zanden, 2013; IMF, 2014.

This divergence reflects poor supply-side performance and diminishing returns to investment in Europe, as both productivity and the output-to-capital ratio have deteriorated in most European countries (Crafts, 2003; Glyn et al., 1988). A 'productivity gap' between Western Europe and the US became evident in the 1970s (van Ark et al., 2008) and kept widening on the back of more intense adoption in the US of information and communication technologies (ICTs) (Crafts, 2011).

The World Economic Forum's Global Competitiveness Index (GCI) consistently puts the US ahead of the EU as a whole. It also highlights a sharp divide in competitiveness within Europe between 'northern' countries, which have similar levels of competitiveness to the US, and 'southern' countries, including Italy and Spain (WEF, 2014a). In 2013–14 the US was ranked fifth among 148 countries, while Finland, Germany, Sweden, the Netherlands and the UK were among the top ten. Other EU countries performed much worse. Italy, in particular, was the least competitive among the largest European economies both before and after the crisis (Table 1.1).

[1] 'Western Europe' is taken in this report to refer to the total of 30 European countries analysed by Angus Maddison (2007). The group includes 30 Western countries – Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, United Kingdom, Ireland, Greece, Portugal and Spain, plus '14 small Westerm European countries'.

Table 1.1: Global Competitiveness Index: country rankings (2008–09, 2013–14)

2008–09	2013–14
United States (1)	Germany (4)
Germany (7)	United States (5)
United Kingdom (12)	United Kingdom (10)
France (16)	France (23)
Spain (29)	Spain (35)
Italy (49)	Italy (49)

Source: WEF, 2009 and 2014a.

Disparities between EU countries are evident in the labour market. The 2007–08 crisis contributed to exacerbating differences within the EU in the level of structural unemployment. Between 2007 and 2013 the unemployment rate in southern Europe rose by ten percentage points, from 7% to 17%. While in countries including Germany, France and the UK the unemployment rate remained stable, in Spain and Greece it increased substantially (by about 8 and 5 percentage points respectively).

Unemployment remains unacceptably high, at 11% for the EU as a whole, while youth unemployment is even higher, at 29%. There are still 20 million people without jobs in the EU, and in Greece and Spain almost 30% of the working-age population are unemployed.[2]

Structural weaknesses and poor economic performance in most countries have been magnified and exacerbated by the financial crisis. In the euro area the constraints posed by the currency union (Pickford et al., 2014) make the adjustment and the expansion of output back to pre-crisis levels extremely difficult.

Despite the positive contribution from net exports, Europe's economy remains crippled by a chronic lack of demand and supply-side weaknesses. Although monetary policies remain accommodative, the combination of the need for fiscal consolidation in many countries and a lack of confidence on the part of corporates and consumers leads to slow growth. Deleveraging and rebalancing are a drag on demand, but there is no way this could or should be avoided. And even once it is completed – after a probably long and painful process – it is not obvious that credit, and notably bank credit, should become the driver of growth (ever) again. The bank-dominated funding system in Europe has over-stretched its limits and failed in terms of selecting and intermediating viable investment projects.

So Europe seems to be locked into low growth, high unemployment and falling living standards. Neither governments nor private sectors are willing to take the actions needed to boost demand, despite extremely low interest rates and favourable conditions for credit-worthy borrowers. At the same time supply-side reforms, which are an essential component of this agenda, are delayed owing to political obstacles. But the delayed implementation of these reforms adds to the risk of weak growth, especially in today's macroeconomic context with significant deflationary pressures (Pothier, 2014). At the same time, sluggish growth makes the implementation of these reforms politically even more difficult.

In such an environment of chronic lack of demand and reduced fiscal policy space, how can economic activity be reinvigorated? In this report we argue that the answer lies in large infrastructure projects, both publicly and privately sponsored. They tend to have large multiplier effects and favourable supply-side effects. In addition, cheap funding owing to abundant liquidity created by the European Central Bank (ECB) in response to the crisis provides a unique window of opportunity. We therefore suggest that the EU and its member governments pick up the tab and launch projects financed by jointly issued eurobonds.

Of course, large infrastructure projects carry the stigma of waste, inefficiency and in some cases even corruption. Europe is littered with too many cases of ill-conceived, badly implemented and over-spent infrastructure projects. Indeed one of the forces that has shaped the sovereign debt crisis was the misallocation of resources, notably in the south, towards excessive infrastructure investments, made possible by cheap financing. At the same time, however, infrastructure deficits are building up in the north, for example in Germany, but northern core economies seem to be reluctant to embark on major infrastructure initiatives. Bad past experience should therefore not be allowed to influence future development, constrain demand and thwart Europe's ability to lead on innovative projects. But there are lessons that need to be taken on board, and this report stresses the importance of choosing 'good' projects.

In a world subject to climate change, ageing demographics, growing inequality, rapid technological advances and greater labour mobility, the social return on infrastructure projects – if well selected and managed – is presumably high, and certainly higher than the current low return on risk-free financial instruments in an environment of abundant liquidity and under-utilized resources.

Infrastructure investment can play a crucial part in breaking this impasse. If economic actors, both public and private, can be encouraged to take advantage of current conditions – where finance is relatively cheap and real resources relatively plentiful – to increase investment in infrastructure, this can create a virtuous circle and kick-start growth. Greater investment can boost domestic demand, especially in the early phases of projects. And if planned and managed well, it can also have important supply-side benefits. The challenge is to design incentives that will encourage both the public and private sectors to realize these benefits with the help of innovative financing.

[2] NEETs (not in employment, education or training) now account for 55% of the population aged between 15 and 24 years in Spain, and 40% in Italy. Even in France and the UK they represent more than 20% of young people.

2. The Long-term Benefit of Infrastructure Investment

Growth, productivity and job creation

Investment is an important driver of economic growth. Not only can it contribute directly to GDP and employment, but also in the longer term it can raise productivity, lower production costs and boost innovation. The Group of 20 (G20) (2013) has recognized that 'sound and sustainable economic growth needs to be firmly based on increased and predictable investments'. And investment in infrastructure features prominently on the G20 agenda for 2014, having been identified as a key area with the potential to drive long-term GDP growth. Australia, as the chair of the G20 this year, has set up a Working Group on Investment and Infrastructure to develop strategies to foster long-term investment from the private sector. At their meeting in Sydney in February 2014, G20 Finance Ministers committed to find strategies to attract capital from institutional investors and to improve the intermediation of global savings through the securitization of infrastructure financing (G20, 2014).

Investment in infrastructure, in particular, creates jobs both directly and indirectly, as these projects tend to have wide spin-offs into other industries. Research by the International Labour Organization (ILO, 2009) shows that an additional $1 billion spent on infrastructure in advanced countries can potentially create up to 28,000 new jobs. The US Department of Transportation estimated that every billion dollars invested in federal highway and transit schemes would support 13,000 jobs for one year, including direct jobs created by the project itself and indirect jobs created by spending on materials (FHWA, 2014).

One caveat here is that the impact of investments in infrastructure on growth and jobs, and their ability to generate long-term benefits, varies across sectors and according to the degree of technology used (Lin and Doemeland, 2012). For instance, labour-intensive infrastructure projects tend to boost short-term growth and jobs in construction, as they are usually based on short-term contracts and require relatively low-skilled and low-productivity labour, compared with more technology- and skill-intensive jobs (Artige and Nicolini, 2006).

Infrastructure projects can also generate significant economies of scale and have a wider impact on growth. New and updated infrastructure can generate productivity gains (Fries et al., 2012) and enhance Total Factor Productivity (TFP) by lowering transaction costs and allowing more efficient use of inputs (Bottini et al., 2012). Network externalities[3] and economic competition can also be enhanced, with lower transportation costs improving market access (Égert et al., 2009). Better transport infrastructure, in particular, can help businesses as well as enhancing productivity and growth.

Physical capital can increase its contribution to economic growth through cross-border effects. For instance, there is empirical evidence from Italy that the provision of transport infrastructure has had a positive influence on GDP growth, but that these effects are even greater when policies are coordinated between neighbouring areas (Di Giacinto et al., 2012). This is a major rationale for the EU's support for Trans-European Networks (TENs) (see Box 2.1).

Box 2.1: The Trans-European Networks (TENs)

The idea of Trans-European Networks (TENs), for transport and energy infrastructures, emerged at the end of the 1980s to support the Single European Market. Freedom of movement for goods, persons and services could be enhanced if the regions and national networks within the single market were linked by modern and efficient infrastructure.

In January 2014, the EU launched a new transport infrastructure policy to close the gaps between member states' transport networks, remove bottlenecks and overcome technical barriers (such as incompatible standards for railways). The new policy triples EU financing to €26 billion in the period 2014–20 and it will set up nine major transport corridors to improve connections between member states.

In terms of energy integration, in 2011 the European Commission adopted a Regulation on 'Guidelines for trans-European energy infrastructure', aimed at completing strategic energy networks and storage facilities by 2020. The Commission has identified 12 priority corridors and areas covering electricity, gas, oil and carbon dioxide transport networks.

The European Investment Bank (EIB) is a crucial actor in providing financial support to TENs projects. Generally the EIB can provide lending up to a limit of 50% of the project cost, but in exceptional circumstances this can rise to 75%. From 2004 to 2013, the EIB committed €75 billion to TENs co-financing.

Technology-intensive infrastructure assets have further potential to increase efficiency and interconnectedness. For example, investing in broadband networks facilitates exchange of data and information, and reduces the costs of doing business between central and peripheral regions. An empirical study on the impact of faster broadband networks in the UK shows an increase of teleworker productivity, higher job creation in rural areas and reduced commuting costs and time (SQW, 2013). Other examples of the benefits from hi-tech infrastructure are 'smart cities', incorporating intensive use of ICT which helps interconnect urban infrastructure assets and improve the provision of public

[3] Network externalities are defined as a change in the benefit, or surplus, that an agent derives from a good when the number of other agents consuming the good changes.

services (Caragliu et al., 2009). 'Space infrastructure', using a network of satellites, can provide support to a wide range of economic sectors, from weather forecasting (which can improve efficiency in other sectors, such as agriculture or tourism) to TV and internet signal distribution (Finmeccanica, 2014).

In Europe, significant differences in the infrastructure endowment help explain the uneven performance between northern and southern EU countries.

Improving infrastructure also has a positive impact on living standards. The Inter-American Development Bank (2014) finds a positive correlation between investment in infrastructure and the growth of GDP per capita. Calderón and Servén (2004) estimate that a 10% rise in infrastructure assets leads to a long-term increase of GDP per capita of between 0.7% and 1%. Although these effects seem to apply at all stages of development, they are estimated to be larger in developing countries which have lower infrastructure endowments (Calderón and Servén 2004; Isaksson, 2009), and these benefits tend to decrease as the stock of infrastructure assets increases (OECD, 2006).

Upgrading existing assets and improving their efficiency can also be as important as providing new assets. McKinsey Global Institute (2013) has calculated that measures to improve existing infrastructure and its management would raise productivity globally by about $1 trillion a year. These measures include the optimization of existing infrastructure portfolios, more efficient delivery through simplifying and harmonizing regulations, better maintenance and constant upgrades. Germany is a case in point. It has good infrastructure assets, but would benefit most by investing in maintenance and upgrading existing assets rather than constructing new ones. Germany made massive investments, especially in the transport sector, throughout the 1990s. However, these assets are progressively deteriorating and need investment in renovation (Kunert and Link, 2013) (see Box 2.2).

In Europe, significant differences in the infrastructure endowment help explain the uneven performance between northern and southern EU countries (Annoni and Dijkstra, 2013). In southern Europe, research and development (R&D) intensity is less than half of that in Scandinavian countries, Germany and Austria, resulting in a sharp divergence in terms of economic competitiveness (Erber and Hagemann, 2013; EFI, 2012).

Box 2.2: Germany: investing in existing infrastructure

Germany has one of the best stocks of infrastructure capital in the world. In the GCI index its infrastructure is ranked 10th globally, and second in the EU behind France. Germany has extensive and efficient roads and airports, rail and port infrastructure and high-quality communications and energy infrastructure (WEF, 2014a). Moreover, the country is located in a strategic position at the core of the EU, making it the backbone of the main TENs (International Transport Forum, 2012).

Germany's outstanding level of infrastructure is the result of massive investment programmes undertaken during the 1980s and the 1990s. However, the country's physical capital, in particular roads, is rapidly deteriorating, and investment in renovation and maintenance of existing assets decreased from an average of €12 billion in the early 1990s to less than €10 billion today (at 2005 prices), leading to an annual 'gap' of €3.8 billion (Kunert and Link, 2013).

Germany needs more investment to sustain the growth of its economy. In particular, additional infrastructure investment requirements are estimated at around €6.5 billion per year for the next 15 years (Kunert and Link, 2013), mainly to finance renovation and technological upgrade of existing assets. This would also have positive spillover effects on the other countries of the euro area, and the increase in domestic demand would help reduce Germany's current account surplus (Odendahl, 2014).

Choosing the right projects, dealing with constraints and removing bottlenecks

Investing in infrastructure involves significant costs and cannot easily be reversed. Therefore, it is important that investment decisions are carefully planned in order to maximize the return on investments in both financial and economic terms, and to allocate finance effectively. This would deliver economic benefits and at the same time attract investors (WEF, 2014b).

The UK case study in Box 2.3 demonstrates the benefits from a comprehensive approach to infrastructure planning. The Italian example, on the other hand, shows the need for effective planning to use EU structural funds (see Box 2.4). EU funds have been a crucial source of public funding for investments, but in many cases they have been spent inefficiently or even remained unallocated. For instance, Italy's State Auditor Department revealed that in 2013 €5.7 billion were not spent because of lack of co-financing by local governments (the required percentage of which is usually between 15% and 25%) and of suitable infrastructure projects. Finally, Spain's investment collapse shows the risk of badly planned projects (see Box 2.5).

Box 2.3: The UK National Infrastructure Plan (NIP)

Britain used to have one of the most mature and extensive infrastructure networks in Europe. But according to the WEF (2014a) its 'quality of overall infrastructure' is now in 24th place worldwide. Shortcomings are particularly evident in transport: roads are heavily congested, railways are expensive and inefficient, and many airports (particularly in London) are operating beyond full capacity (Aghion et al., 2013).

In order to improve domestic infrastructure, the UK government launched a National Infrastructure Plan (NIP) in October 2010 (HM Treasury, 2010). The first NIP update in 2011 identified 40 key areas where infrastructure investment was needed, each representing major programmes and significant individual projects (HM Treasury, 2011). In 2012 the government identified a further 550 projects, costing £375 billion. One third of those projects are expected to be delivered between 2015 and 2020, with energy and transport accounting for nearly 90% of the total (HM Treasury, 2012).

UK airports provide a good illustration of the need for improvement in Britain's transport networks. Punctuality at UK's major airports is the biggest challenge, with a deteriorating record since 2005 (HM Treasury, 2011). But while some of the large airports are already running at their maximum capacity, others are under-utilized (HM Treasury, 2011). The government forecasts that the number of passengers using the UK's airports will rise from 211 million per annum in 2010 to 335 million in 2030, and to 470 million in 2050.

Other infrastructure projects in the NIP include spending more than £60 billion on UK railways between 2011 and 2021, including Crossrail, Thameslink and High Speed Two (HM Treasury, 2013). In the latest NIP report, the government has committed to publicly fund projects worth more than £100 billion, to be carried out by 2020.

Box 2.4: Italy and the EU structural funds

The economically disadvantaged regions in southern Italy have traditionally received a greater share of public investment than the north. Until the early 1990s southern Italy received 35% of public investment in infrastructure, compared with its 25% share of national GDP). But as the economic crisis led to a sharp decrease in such investment – by 25% between 2009 and 2013 (Bank of Italy, 2014) – this reduction mainly affected southern Italy. The private sector has not stepped in and remains reluctant to invest in the south of the country because of corruption, criminality and excessive bureaucracy (Di Giacinto et al., 2012).

The result is a long-standing gap between northern and southern Italy. Despite having benefited also from EU structural funds, southern Italy still has a much smaller infrastructural physical capital than the north, as illustrated in the diagram below. Disparities are evident not only in transport networks, but also with respect to power generation and implementation of alternative and renewable sources of energy (Unioncamere, 2011). More than 600 infrastructural projects remain currently incomplete (Sistema Informatico di Monitoraggio delle Opere Incompiute, 2014). Moreover, insufficient interconnections between existing assets (ports, railways and roads), as well as complicated and lengthy bureaucratic procedures (Montanaro, 2011), increase transportation costs and reduce the competitiveness of Italy's economy.

Railways in Italy (km per every 100 km^2 of territorial surface, 2012)

Source: Bank of Italy, 2014.

Box 2.5: Spain's investment rise … and fall

There are 48 airports today in Spain, but only 11 of them are profitable: many of the others are still incomplete or not operating at full capacity. In Guadalajara, the AVE (high-speed railway) station is 8 km from the city centre and was used in 2010 by an average 19 passengers daily (Bel, 2012). Spain's high-speed railways cost €46 bn and form the most extensive network in the EU (2,144 km), although they are significantly under-utilized (Simancas, 2012). Road usage decreased by 3.6% between 2009 and 2012 (Ministry of Public Works (Spain), 2013). Spain's public investment in infrastructure in the period 2005–10 amounted to €248 bn. The question is whether this was an efficient use of expenditure.

It is undeniable that Spain has rapidly caught up with other European countries in terms of the endowment and quality of its road, rail and telecommunications networks, thanks to investment in modernization that was higher than the EU average, relative to its GDP. Government investment in infrastructure was also designed to create jobs: in the immediate aftermath of the economic crisis, a €11 bn stimulus package was introduced, of which €8 bn went to public works projects in order to fight rising unemployment.

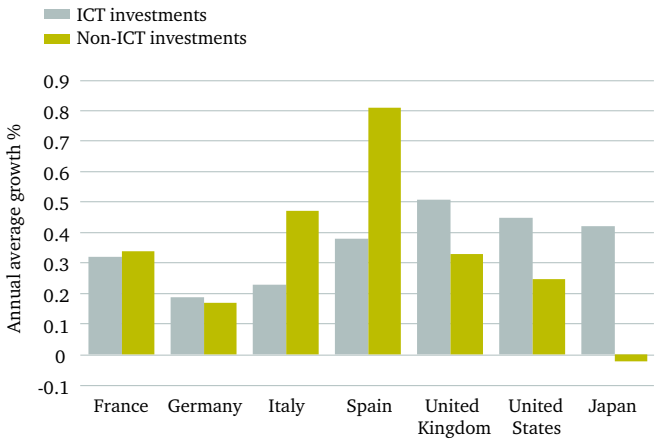
However, this strategy was only partially successful. There was too much investment in low-return projects that did not succeed in reducing unemployment. Moreover, investment was unevenly distributed and concentrated in more developed regions, thereby increasing the competitiveness gap with more peripheral regions (Bel, 2012).

Today, few new public projects are being started, and current works are being delayed. Private investors are suffering from a lack of funding for big PPP projects. Only a few banks are willing to lend for infrastructure projects, and even then are not prepared to take on much risk. Big projects are on standby or are being carried out slowly (Ernst and Young, 2013).

Investing in high-return infrastructure

Both the Organisation for Economic Co-operation and Development and the European Commission have concluded that countries which have invested more in ICT have experienced the highest productivity increases in recent years (OECD, 2006: EC, 2006b) (Figure 2.1). In the US and the UK ICT investment overall contributed to approximately 29% and 20% of GDP growth, respectively, over the period 2000–09. In Spain the contribution was 16%. This contrasts with the 36% contribution from non-ICT investment, in particular in the housing sector.

Figure 2.1: Contribution of ICT investment to GDP growth (annual average growth %, 2000–09)



Source: OECD, 2011.

In Europe, the less advanced regions in terms of R&D have predominantly relied on capital accumulation rather than technological enhancement to increase labour productivity. In most cases, however, they failed to narrow the productivity gap with more advanced regions (Peyrache and Filippetti, 2012). In contrast, countries which invested more in ICT, such as Belgium, Denmark and the UK, have been able to boost growth by introducing new technologies and generating faster growth in multi-factor productivity (EC, 2006b).

Even high-tech investments need to be planned carefully. For instance, incorporating new technologies which have not been properly tested can be detrimental for investment performance. In Germany, a new tolling system for heavy trucks on the domestic motorways nearly failed in the early 2000s as it was based on unreliable software. One year after being put in place the project was falling apart, and the shortfall in expected toll revenues put other public works on hold, threatening up to 70,000 jobs (Flyvbjerg, 2009).

A balance between public and private investment

In many European countries both public and private sectors have historically played critical roles in infrastructure financing. The public sector was the main provider of infrastructure for most of the 19th and during the 20th century, especially in the transport and telecommunications sectors. For instance, the road and the railway systems in France were predominantly funded by the government (Margairaz, 2009), since these infrastructure networks needed to be built from scratch and required huge and very risky investments (Agic and Grove, 2012). In the post-war years, the public sector has been the main driver for investment in infrastructure in the largest EU countries.[4]

[4] From 1960 to 2011 the government accounted, on average, for 55% of the investment in Germany and 54% in France (G30, 2013).

However, public investment in Europe has been on a declining trend since the late 1970s, when supply-side reforms were introduced to public services such as electricity and gas, water, communications and transportation (Clifton et al., 2011), with the UK taking the lead. At the EU level, such reforms intensified during the 1990s[5] as market integration and liberalization policies were applied to infrastructure sectors (Bognetti and Obermann, 2008).

Over time fiscal capacity to accommodate high levels of public investment has shrunk in the EU. Public investment fell from about 4.5% of GDP in the 1970s to less than 2.5% in the 2000s (Inderst, 2013). In the four largest countries (France, Germany, Italy and the UK) it halved from 4% of GDP in the early 1970s to around 2% of GDP in recent years.

From 2006 to 2009 total investments in infrastructure in the EU were on average 3.9% of GDP in the old member states, and less than half of that was funded by governments.[6] During this period, most investment went into the transport sector (56% of total infrastructure investment, both public and private, in the EU), followed by utilities (18%), health (15%) and education (10%). Nearly 90% of public investment went into education, whereas private investment provided the majority of total investment in the other three areas (transport, utilities and health) (Wagenvoort et al., 2010).

Box 2.6: Critical infrastructure protection – a business case

In many countries critical infrastructure assets are privately owned and operated in regulated markets. The main driver in the market is money, followed by regulation, operational efficiency, image, risk, resilience and security.

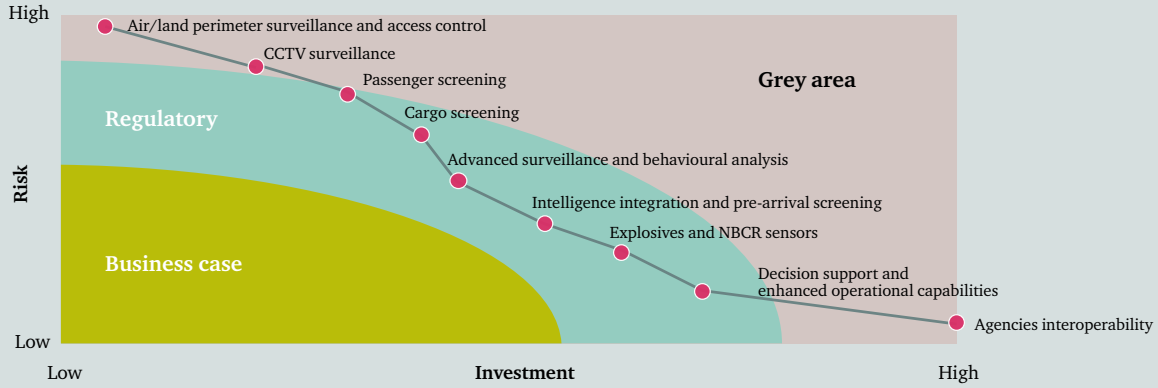
The diagram below shows the optimal curve in a bi-dimensional scenario where investment (X axis) is represented together with risk (Y axis). Considering an airport as an example of critical infrastructure, in order to progressively reduce risk, more and more investment in high-tech solutions is needed, such as electro-optic sensors, scanners, radio frequency identification, intelligent closed circuit television, data fusion, intelligent event management software and integrated communications networks.

However, it is clear that the investment required to mitigate the risk is desirable within the framework of market competition up to a certain point (represented by the green area). Then public regulation steps in, forcing investments that contribute to lowering risks and improving security for the benefit of society (yellow area). Nevertheless, a grey area will remain. In that area, responsibility and ownership are not completely clear.

A number of questions naturally arise. What is an acceptable level of risk? How can full coverage of security needs be maintained? Where will technology go? And, most importantly, who can pay and take on the responsibility for providing an adequate level of security?

The challenge of finding new and innovative pay-back and reward mechanisms in maintaining, managing and upgrading critical infrastructure might attract both institutional and private investors. They could take responsibility for the continuous development and improvement of the high-tech security and safety systems and solutions that countries require to ensure an effective and efficient network of critical infrastructure.

Risk vs investment related to critical infrastructures



Source: Finmeccanica, 2014.

[5] The process of liberalization in the EU began in the late 1980s after the publication of the UK White Paper *Completing the Internal Market*, aiming to create an integrated market and liberalize the supply of public utilities. Liberalization began with gas (1988), followed by broadcasting (1989), telecommunications (1990), rail (1991), air transport (1992) and the postal sector (1994) (Bognetti and Obermann, 2008).

[6] Infrastructure investment is significantly higher in the new member states (i.e. those that joined in/after 2004). The ratio of infrastructure investment to GDP in these states was 5.1% on average between 2006 and 2009. During the same period, Spain was the only country among the largest old member states that reached a similar ratio of total infrastructure investment to GDP, at 5% (Wagenvoort et al., 2010).

The decline of public investment in infrastructure was primarily due to the unsustainability of investing and maintaining infrastructure for government budgets, and inefficiencies in the provision of services (Sutherland et al., 2011). In the 1980s the privatization process started in many developed countries. Over the last three decades, in Europe as well as in many other OECD countries, the role of the state in the ownership and management of these infrastructure networks has declined substantially (Sutherland et al., 2011). However, while privatization helped to shift the financial burden from the state, pricing and regulatory issues remained (Helm, 2013).

Today, the appropriate roles for the private and public sectors in the provision, management and maintenance of infrastructure assets remain an issue. For some categories of projects, especially those involving the provision of 'public goods' infrastructure (such as free public roads and social infrastructure) or 'critical' infrastructures (see Box 2.6), the private sector is often reluctant to take on the risk that is involved in these projects.

Other problems related to the provision of infrastructure are also likely to arise. For instance, in cases of 'public goods' assets, there are often insufficient economic incentives for the private sector. This makes it difficult to recover fixed costs, which arise in the initial stage of the investment, without distorting consumption (Helm, 2010). The existence of negative externalities is another factor that frequently prevents the supply of infrastructure from matching demand. These externalities are often environmental – for example leading to increased pollution or a reduction in biodiversity (Helm, 2010) – or social (for instance, affecting the quality of life of people living near the investment, leading to 'NIMBY' – not in my back yard – reactions). Finally, the existence of natural monopolies (or oligopolies) in many infrastructure sectors often constrains economic competition, keeping prices high and reducing incentives for technological innovation.

Where these economic distortions occur and the market alone cannot provide the optimal level of infrastructure, the role of the public sector remains crucial, in terms of both infrastructure provision and market regulation.

3. The Future Infrastructure Gap and Current Investment Trends in Europe

The global demand for infrastructure

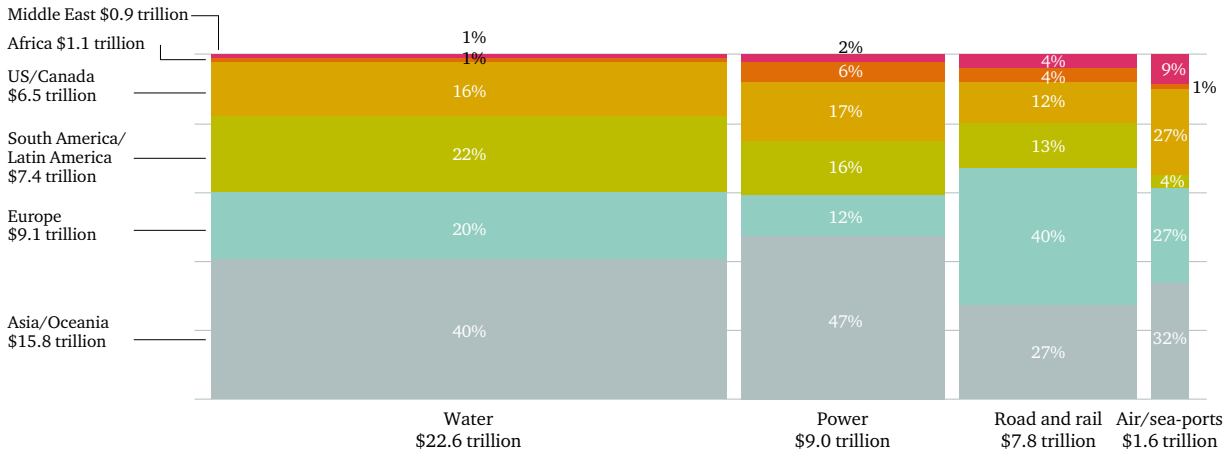
Infrastructure demands will continue to increase as the world population grows and as expectations of high quality and reliable services rise. Over the next three decades, the global population is expected to grow by at least 25%, rising to around nine billion by 2050 (Ottesen, 2011). Most of this increase will take place in the largest cities around the world, and more than 50% of the global population will be living in urban areas. By the middle of the 21st century, the global urban population will almost double, from approximately 3.4 billion in 2009 to 6.4 billion in 2050 (WHO, 2014). In the EU, more than two-thirds of the population lived in urban areas in 2013,[7] and this proportion is likely to rise to about 80% by 2020 (EC, 2014a). As the population grows, demand for water, electricity, and transportation will continue to expand.

Many cities, and countries, are not ready for these challenges. Some large cities, especially old ones, will need to be extensively 'modernized' in terms of transport, energy, water and communications systems. The city of Cairo, for example, is seriously constrained by poor water infrastructure. Its residents regularly endure low water pressure and high levels of lead contamination owing to the contamination and deterioration of the city's water and sewage systems (Doshi et al., 2007). Cities in developed countries also face infrastructure challenges. In July 2007, the explosion of a 100-year old steam pipe in the New York City killed one person and created havoc in midtown Manhattan. In the same year a major bridge in Minneapolis suddenly collapsed during the evening rush hour, killing 13 people and injuring more than 150.

Older infrastructure is more prone to severe disruptions. When people are forced to live without the basic services – transport, heat, water, and telecommunications – that they normally take for granted, governments come under pressure to act. For instance, flooding in the UK in February 2014 affected large parts of southern England, cutting off supplies of electricity and drinkable water to more than 5,000 households and businesses, and causing massive disruption on the rail network and major roads. Likewise, in 2012 the New York subway system was shut down for days by Hurricane Sandy,[8] which flooded parts of the city. The damage was so extensive that repairs are still ongoing nearly two years later.

It has been estimated that at least $40 trillion will be needed for infrastructure investments in cities globally up to 2030 (Ottesen, 2011) to modernize and upgrade water, electricity and transportation systems[9] (Figure 3.1). Overall, this is equivalent to the total market capitalization of all listed companies in the world in 2007 (Doshi et al., 2007). With large and fast-growing populations, the Asia/Oceania region will have the greatest demand for urban infrastructure ($15.8 trillion between 2005 and 2030). Europe will have the second largest demand – over $9 trillion – for total investment in urban infrastructure, principally for water and transportation systems.

Figure 3.1: Total projected cumulative investment needed for urban infrastructure by 2030, by region and sector (%)



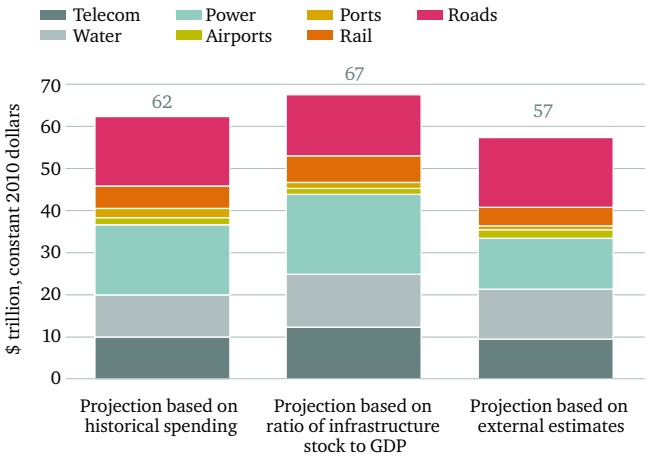
Source: Doshi et al., 2007.

[7] According to the classification of urbanization published by the European Commision (Dijkastra and Poelman, 2012), urban areas include cities, towns and suburbs in the EU.
[8] Hurricane Sandy (unofficially known as 'Superstorm Sandy') caused the sudden inland rush of water from New York harbour on 29 October 2012.
[9] Here the transportation system includes both *Road and rail* and *Air/sea-ports*, as shown in Figure 3.1.

The OECD has also produced a long-term assessment of the global infrastructure need to 2030. The final report (OECD, 2007) covers all OECD member countries as well as the BRICs (Brazil, Russian, India and China) and estimates that cumulative infrastructure requirement in five main infrastructure areas – electricity, water, rail, road and urban public transport infrastructure – will total roughly $53 trillion up to 2030. Adding in electricity generation would raise the estimate to around $65 trillion, and the inclusion of other energy-related infrastructure investment would take it up to more than $70 trillion. If airports and shipping ports are also taken into account, aggregate global infrastructure demand to 2030 could exceed $82 trillion – an annual global requirement for infrastructure investment of nearly $3 trillion (4% of world GDP).

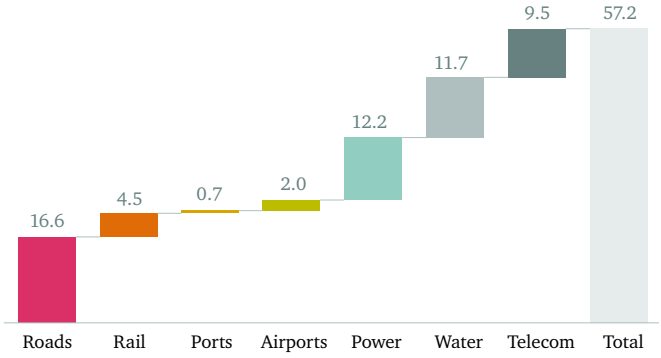
The OECD may have over-estimated infrastructure demand since the assessment was based on more optimistic GDP projections made prior to the crisis. But even conservative estimates still suggest an enormous global demand for infrastructure. McKinsey (2013) expects baseline demand of global infrastructure investments from now to 2030 of between $57 trillion and $67 trillion (in 2010 constant dollar prices; Figure 3.2 and Figure 3.3) for the largest 84 countries. About 3.5% of global GDP would need to be spent on infrastructure each year just to keep up with projected world GDP growth.[10]

Figure 3.2: Estimation of infrastructure investments needed from 2013 to 2030 ($ trillion, constant 2010 dollars)



Source: McKinsey Global Institute, 2013.

Figure 3.3: Breakdown of minimum global investment in infrastructure, 2013–30 ($ trillion, constant 2010 dollars)



Source: McKinsey Global Institute, 2013.

In fact demand for infrastructure investment is very likely to exceed this minimum estimate. In 2013 world spending in seven main infrastructure areas[11] averaged about 3.8 % of global GDP.[12]

Moreover, this estimate does not include expenditure on maintenance and renewal of existing facilities. For instance, in the US, the inland waterways system, which is vital for commercial transport routes, would require spending on maintenance and renovation of roughly $13 billion by 2020 just to keep up with the current traffic and volumes (Stratfor, 2013). Japan has an even more acute need of infrastructure, especially after the disruptive earthquake of 2011. Restoration and renovation works would cost the Japanese government an additional ¥25 trillion ($202 billion) (Ministry of Foreign Affairs of Japan, 2013).

Europe's future demand for infrastructure investment

How large will Europe's demand for investment in infrastructure be between now and 2030? The EC (2013a) estimates the need for investment for EU transport, energy and telecomms between 2013 and 2020 at €1 trillion. This estimate, however, excludes expenditure on water, sewage and waste management. Nor does it include spending on maintenance. Therefore the overall demand for the new construction of a whole range of infrastructure as well as the need for project renewal and maintenance is expected to exceed the aggregate total of €2 trillion suggested by the European Commission.

[10] The minimum estimation of $57 trillion is based on the assumption that the annual infrastructure investment remains a constant share (3.5%) of the world's GDP from now until 2030.
[11] As shown in in Figure 3.2, the seven areas include roads, railways, ports, airports, power, water and telecommunications.
[12] This spending is not evenly spread across countries. For instance, Japan has spent 5% of GDP in infrastructure investment, while Brazil and Mexico have committed only 2.3% and 1.4% respectively of their GDP over the past 18 years (Moody's, 2014).

Projections from the EIB (Inderst, 2013) for investment needed up to 2030 are broadly comparable with the McKinsey estimates of global investment demand. The EIB looks at three scenarios (Table 3.1). Based on past needs (see column 2 in Table 3.1),[13] Europe needs infrastructure investment of €470 billion a year and a total investment need of over €8.4 trillion until 2030. In the most ambitious scenario,[14] the annual investment demand rises to more than €800 trillion a year, or 5.7% of EU GDP in 2013, with a total demand of nearly €14.6 trillion by 2030.

Table 3.1: Scenarios for EU infrastructure investment needs (2013–30, € billion)

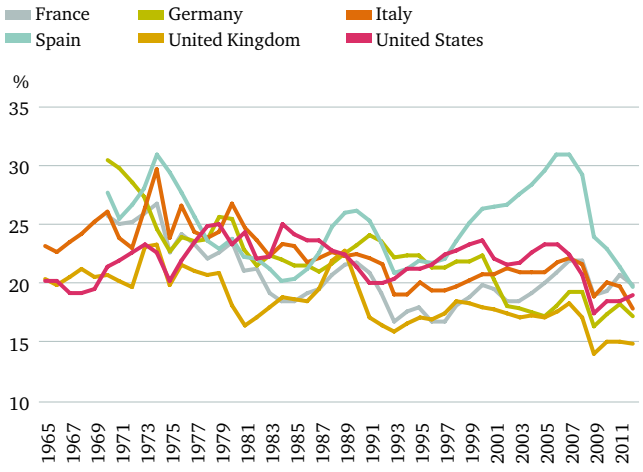
	Historical	Plus 1% social infrastructure	Future scenarios	
Scenario: as % GDP	**A. 2.6%**	**B. 3.6%**	**C.4.0%**	**D. 4.5%**
Total over 18 years	8,400	111,600	12,900	14,600
Annual average	470	650	720	810

Source: Inderst, 2013.

The outlook for Europe

Low levels of investment in Europe have become a structural problem, and have been exacerbated by the effects of the global financial crisis.

Figure 3.4: Investment to GDP ratio in the US and European countries (%, 1965–2012)



Source: World DataBank – World Development Indicators, 2014.

Investment in Europe as a proportion of GDP has been on a declining trend since the mid-1960s in most of the major countries (Figure 3.4). The ratio of investment to GDP has also fallen in the US, but by less than in Europe. The transition from manufacturing to services in advanced economies partly explains these trends.

The financial crisis further contributed to the decline in investment. In the EU, overall investment dropped sharply after the start of the financial crisis – from 21.3% of GDP in 2007 to 17.3% in 2013. Private-sector investment decreased by 14.5% between 2007 and 2011. 'Southern' countries experienced an even stronger drop in investment. In Spain it decreased from 30.7% of GDP in 2007 to 17.7% in 2013, while in Greece it fell from 26.6% to 13.2% over the same period. Private investment also fell sharply in the UK, accounting for one-fifth of the total private investment reduction in Europe from 2007 to 2011 (McKinsey Global Institute, 2012).

Construction and real estate accounted for nearly 50% of this contraction in private investment in Europe, which was concentrated in Greece, Portugal, Spain, Ireland, Italy and the UK. In these countries real estate investment had been fuelled by speculative financial bubbles, relatively easy credit and foreign capital inflows (Kollmann et al., 2014).

Investment in infrastructure: resources and instruments

Infrastructure funding is provided by both public and private sectors. Traditional public procurement and projects that are exclusively financed through public sources are classified as the two main components of government funding. Private funding consists of two main types of capital: *corporate finance* from operational and services companies in infrastructure sectors, and *project finance* in the form of public–private partnerships (PPPs) and other types of contractual financing arrangements (Wagenvoort et al., 2010; Inderst, 2013). Albeit with some caveats,[15] this framework provides a practical way to categorize Europe's infrastructure investment (and is also used by statistics offices and research institutes).

With regard to instruments, infrastructure projects can be financed through debt, equity or a mix of the two. The former includes bank loans and bonds (issued by the public or by the corporate sector), while the latter includes shareholdings of both listed and unlisted equities linked with infrastructure

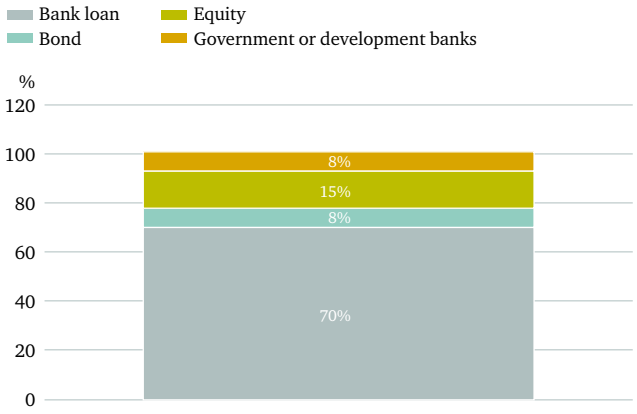
[13] The underlying assumption of this scenario (scenario A in Table 1) is based on a constant share of infrastructure spending of 2.6% of GDP.
[14] Scenario D assumes infrastructure spending constitutes a constant 4.5% share of GDP.
[15] Two caveats should be noted in the EIB's 2010 analytical framework. First, investments by government-owned corporations were classified as private infrastructure finance. This may have exaggerated the share of such finance as it neglects governments' dominant role as large shareholders in state-owned companies. Second, all PPPs were classified as private finance under this framework. However some of these PPPs may overlap with government's investment in traditional procurement. Eurostat's data include PPPs as part of the government balance sheet, but this method leads to a potential over-estimation of government finance.

companies. Hybrid instruments such as mezzanine capital can also play a role in financing infrastructure. Public or semi-public institutions such as national development banks can provide further support to achieve the funding required through different types of financing schemes.

Debt and equity have specific advantages and disadvantages. Debt allows a business to fund its initial operations in advance of income streams from the project, without requiring it to share ownership or control of the business. However, there are constraints on a company's ability to borrow. In order to be able to access capital through debt, a company will usually need to provide collateral for the loan (such as the infrastructure asset itself). On the other hand, equity financing does not have a prior claim in the event of insolvency and it allows the business to share risks with the buyers of the equity. For a company, a low debt-to-equity ratio is also helpful when and if a bigger loan is needed. Besides giving up some control of a company, equity financing has some other costs. For instance, raising equity involves larger legal, accounting and investment banking fees, which can add at least 3–5% of the amount raised (PwC, 2013a).

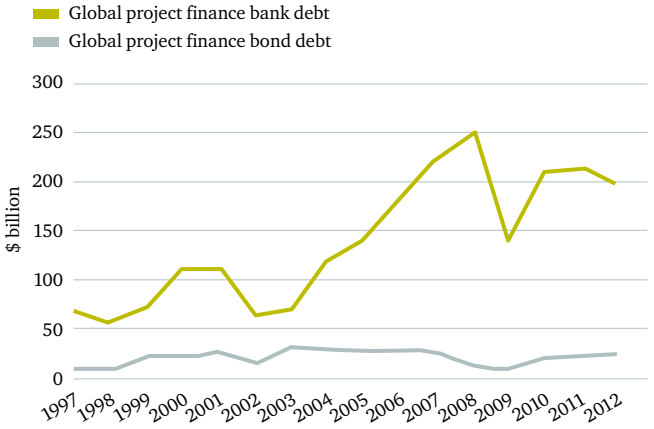
At the global level, debt usually comprises between 70% and 90% of an investment project's financing structure (on average, 70% is represented by bank loans and 8% by bonds), and the share of equity is estimated at between 10% and 30% (WEF, 2014b; Swiss Re, 2014; Figure 3.5 and Figure 3.6). In Europe the share of debt is estimated at about 85% (HLEG, 2013). Historically, the European project finance debt market has been dominated by banks which represented 90% of debt funding, with only 10% coming from other instruments such as project bonds.

Figure 3.5: Indicative global infrastructure financing structure



Source: Swiss Re, 2014.

Figure 3.6: Global project finance – bank and bond debt ($ billion)



Source: WEF, 2014b.

Banks and capital markets

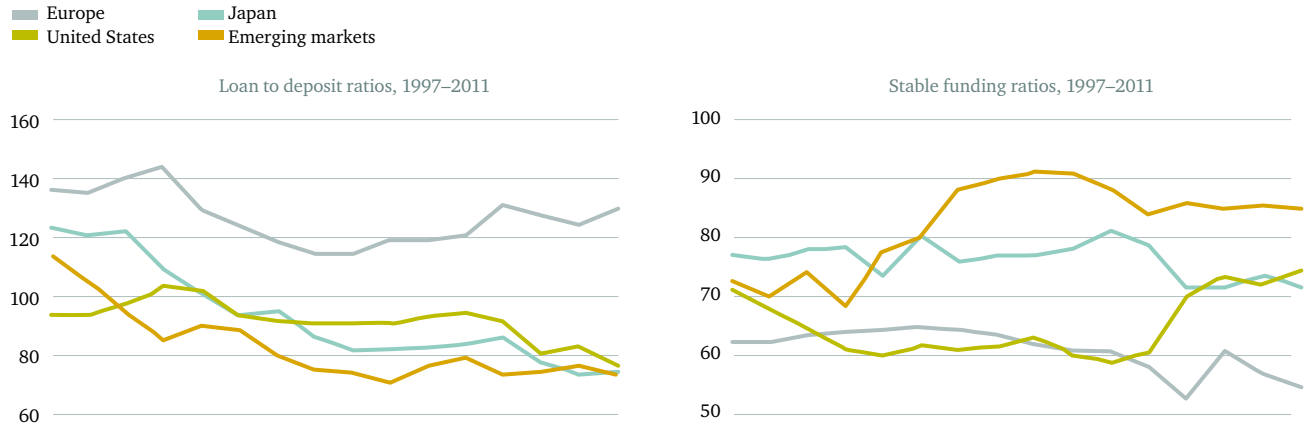
Infrastructure companies in Europe are generally non-financial corporates and depend on banks for most of their debt finance. In 2011 bank loans accounted for 85% of total non-financial corporate debt outstanding in the euro area and in the UK (Llewellyn and Dharmasena, 2012).[16] But European banks are still repairing their balance-sheets, scaling back infrastructure loans and shifting to lending for projects with shorter maturities (World Bank, 2013).

The recent financial crisis and the regulations that ensued have constrained the funding capacity of the banking system. Although the total volume of bank loans continued to rise in the midst of the crisis in 2007–08, it dropped substantially in 2009, by more than 25% from the peak of $250 billion in 2008. Since 2010, banks' funding capacity has recovered to between $180 billion and $210 billion. But the new 'Basel III' rules[17] are steering banks away from the long-term loans required by backers of infrastructure projects. Furthermore, banks not only face higher regulatory costs with long-term loans, but are also reluctant now to take on as much risk as before. While they used to be happy to lend 90% of the construction cost of a large project, the proportion today is down to about 70% (Swiss Re, 2014).

The situation is particularly difficult in Europe as banks have traditionally been the most important source of finance in the region. Europe's high dependency on bank intermediation is reflected in the large share of the banking

[16] Non-financial corporate bonds accounted for the remaining 15% in Europe. By contrast, in the US, the difference between the proportions of bank loans and cooperate bonds was only 6% (53% and 47%, respectively, in 2011).
[17] The new capital adequacy framework, named 'Basel III' after the Basel Committee of Banking Supervision which elaborated it in 2010 with the support of the G20, requires that commercial banks increase the common equity tier 1 ratio from 2% to 4.5%.

Figure 3.7: A bank lending gap in Europe



Source: EC, 2013b.

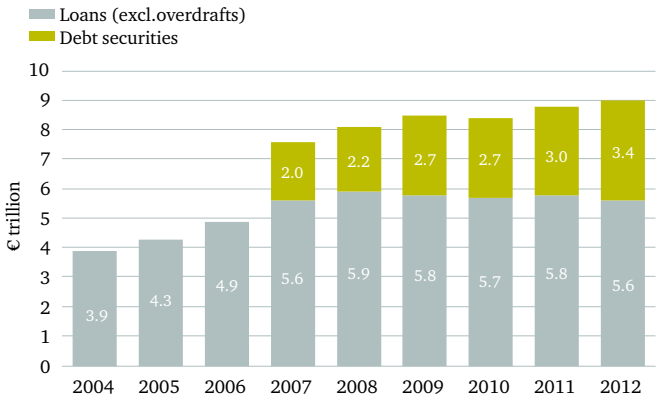
sector in EU member states, relative to international standards (EC, 2013a). In the years running up to the crisis, European banks had significantly higher loan-to-deposit ratios than non-European banks (Figure 3.7), and they relied heavily on short-term credits from wholesale creditors to fund long-term lending. Although the crisis exposed such vulnerabilities, and new regulations compelled the banks to change their behaviour, even after 2008 the loan-to-deposit ratio in Europe remained relatively high (130% on average in 2011), while in the US it has fallen from around 95% to 75% since the onset of the crisis (BIS, 2012).

Despite the constraints on bank finance, new issuances in Europe's bond markets for new infrastructure projects almost completely disappeared from 2008 to 2010.

Also since the start of the crisis, European corporates have gradually relied more on market-based funding from capital markets. In the euro area, in contrast to the tight conditions for bank credit, debt securities – especially corporate bond markets – have grown in importance as alternative financing sources. From 2007 to 2012, the total outstanding corporate debt (loans and debt securities) for non-financial corporates in Europe increased by 20% – from around €7.6 trillion in 2007 to nearly €9.0 trillion in 2012 (Figure 3.8). The rise in debt securities accounted for most of this growth. In this period, the balance of outstanding loans declined at 2% per year between 2008 and 2012 (AFME, 2013).

However, the corporate bond market in the EU, particularly in the euro area, is smaller than in the US and is currently not deep enough to offset the shortfalls in bank credits (EC, 2014b). In the US, outstanding public and private debt securities totalled $36.4 trillion in 2012, significantly higher than in the euro area ($21.6 trillion). Compared with the economic size of the region, the euro area bond markets were equivalent to just over 160% of the euro area GDP in 2012, considerably lower than in the US (around 220%).

Figure 3.8: European non-financial corporate debt outstanding by asset class (€ trillion)

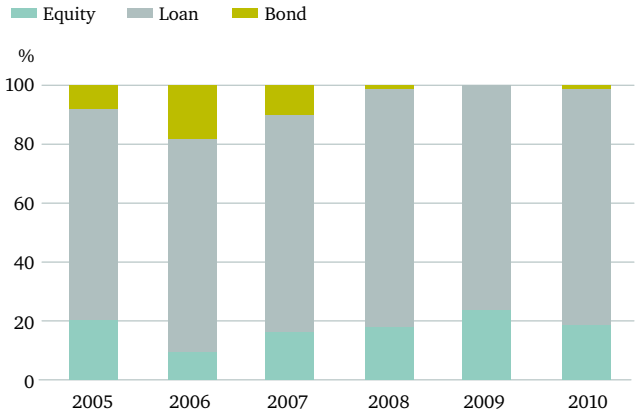


Source: AFME, 2013.
Note: Outstanding volumes as at year end. Debt securities include all long- and short-term debt securities excluding shares and derivatives; full dataset not available for debt securities before 2007.

Despite the constraints on bank finance, new issuances in Europe's bond markets for new infrastructure projects almost completely disappeared from 2008 to 2010 (Figure 3.9). Although many European corporations have switched to the bond markets to re-finance existing debt, this does not seem to have been the case for new infrastructure projects. Many practitioners believe that the disappearance

of monoline insurers[18] in the early stages of the crisis is very likely to be the key factor behind this dramatic change (AFME, 2013; Wells Fargo, 2008). Prior to the crisis, infrastructure bonds were guaranteed by monoline insurers in order to spread the development risks of a single project;[19] but after the crisis new issuances of infrastructure project bonds were largely suspended owing to the absence of these insurers (EIB, 2010).

Figure 3.9: Financing infrastructure projects in Europe in old member states



Source: Inderst, 2013.

Uncertainty and risk aversion constrain investment

Uncertainty and risk aversion created by the financial and economic crisis have also affected both the demand and the supply of long-term financing, leading to a sub-optimal equilibrium. On the demand side, the requirement from small and medium-sized enterprises for long-term financing for investment projects has decreased. On the supply side, the increase in financial investors' risk aversion has led to a preference for more liquid assets with shorter maturities (EC, 2014c). The new financial regulatory framework established in the aftermath of the crisis is also playing an important role in constraining capital availability for long-term projects. The Basel III reforms and the Solvency II Directive, which respectively apply to banks and insurance companies, impose higher capital requirements and additional prudential rules to ensure they are able to cover the form and duration of their liabilities (EC, 2013b). For instance, the Net Stable Funding Ratio (NSFR), a specific provision contained in Basel III, aims to ensure that banks hold a minimum amount of stable funding based on the liquidity characteristics of their assets and activities over a one-year time-scale. The two regulations apply similar rules, reflecting a common objective – to improve the ability of banks and insurance companies to absorb shocks arising from future financial and economic stress. This prevents insurance companies from unlocking more long-term financing (Bassanini and Reviglio, 2011) and providing a stable alternative source of capital. However, the European Commission is taking actions to mitigate these undesirable effects of Solvency II, by postponing its implementation to 2016 and allowing more flexibility in its provisions (EC, 2014e; Solvency II Wire, 2014).

Nevertheless, the Basel III regulatory requirements could increase the cost of long-term bank lending, or reduce its supply (FSB, 2013). This new set of regulations could also affect other sources of debt financing. Although the Basel III rules do not strictly apply to long-term investors such as insurance companies, pension funds, sovereign wealth funds (SWFs) and development banks, they set the ground for regulation regarding other long-term players, such as institutional investors (Bassanini and Reviglio, 2011).

Infrastructure projects are likely to be affected by these new regulations. Simulations by Standard & Poor's (2013) envisage additional bank borrowing costs in the euro area for construction companies of between €30 billion and €50 billion per year once the new regulations have been fully implemented in 2018.

There are other constraints also on the financing of infrastructure projects. The OECD (2012) lists as major problems the lack of appropriate financing vehicles and debt instruments, inappropriate mechanisms for risk transfer, and limited availability of transparent and high-quality data related to infrastructure projects.

With respect to financing vehicles, small projects in sectors such as social infrastructure are often unable to attract investors' attention. This problem could be addressed by 'aggregators'. These are vehicles for pooling funding for projects that are not large enough. The 'aggregators' can help achieve credit enhancement both by banks and through other forms of debt. The UK leads in this respect. The 'Priority School Building Programme' (PSBP) is a centrally managed programme launched to improve the condition of the schools most in need of urgent repair. The programme

[18] Monoline insurers provide specialized expertise and insurance services that focus on a specific area. They offer investors and debt issuers the confidence to tap into the capital market by providing liquidity and financial protection. They also act as a single mediator between the bond-holders and project-owners by providing specialized services and information.
[19] For infrastructure projects, the monoline insurer is the single mediator that not only provides specialized expertise and insurance services, but also offers a guarantee for the bonds issuer, which helps to enhance the credit of projects rated at or lower than A-.

is now financing renovation works at 215 schools with total funding of £700 million (Education Funding Agency, 2014). Eventually, it will provide support for 261 (Department of Education, 2014).

In terms of instruments, the fall in credit provision from banks has not yet been offset by an increase in the issuance of corporate bonds sufficient to fill the 'gap' in long-term lending. Even though issuance of corporate bonds (and especially project bonds) has been on the rise recently, the potential of such debt instruments has not been fully exploited.[20]

Finally, there are also non-financial constraints on the implementation and delivery of infrastructure projects. Transparency and availability of high-quality data on projects is crucial to enable investors to assess risks embedded in specific financial assets and understand their correlation with other securities. The complexity of projects and fragmentation of planning among different levels of government reduce clarity and hence incentives to investors (Institute of International Finance, 2014). This helps explain why, of the 30 European projects identified as priorities within the TENs framework since 2004, only five have been completed (Natixis, 2013). An assessment of the Private Finance Initiative (PFI) in the UK revealed that lack of transparent information caused problems in terms of delays or cost overruns which were not correctly forecast (National Audit Office, 2011). Therefore, improving the quality and detail of information to allow benchmarking of investment in infrastructure through a clear identification of risks and performance would help to balance out demand for and supply of long-term capital (Blanc Brude, 2014).

[20] For a detailed explanation, see Chapter 4.

4. Infrastructure Projects and Financing Models

The complexity of infrastructure projects

Infrastructure projects are complex to develop. They require considerable resources in both human and financial capital. On average, projects have long life-spans of 15–20 years. They usually take a long time before becoming profitable, as they only generate a stream of revenues in the operational phase. Therefore, investors have to be prepared to finance the planning and construction stages in advance of receiving revenues. For instance, the Channel Tunnel between the UK and France was initiated in 1986 and opened in 1994, but started to pay dividends to its shareholders only in 2009 (*The Economist*, 2014 – see Box 4.1). Moreover, as infrastructure involves highly regulated sectors, investing in these projects requires specific skills and knowledge in order to manage complexity and risks throughout their different phases.

Box 4.1: The Channel Tunnel project

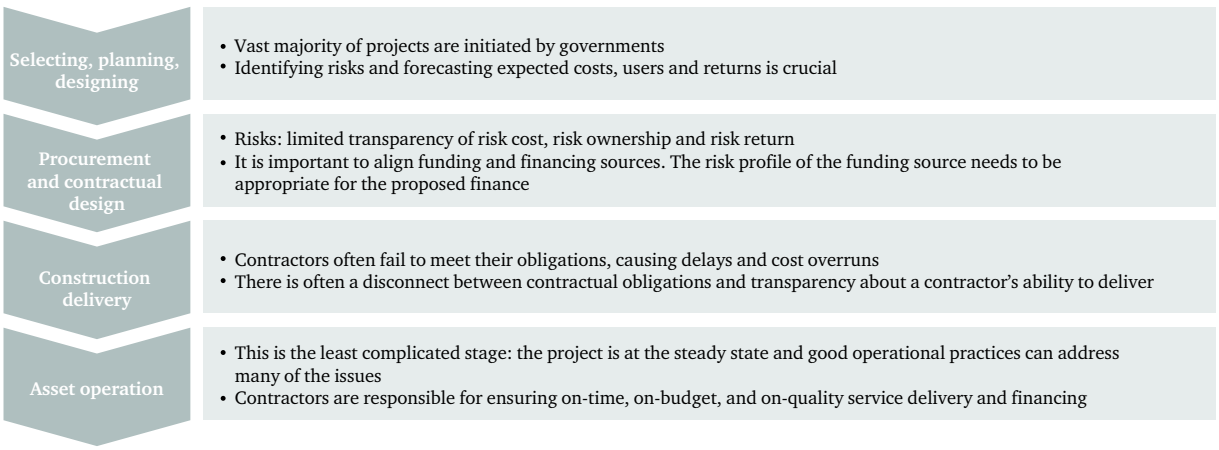
The Channel tunnel was inaugurated in 1994, eight years after the construction works started, and built by a French–British consortium, Eurotunnel. The project was developed as a form of PPP through a concession agreement with the concessionaires (The Channel Tunnel Group Ltd and France-Manche SA).

The project was very innovative. However, it faced several major problems. Over-optimistic *ex ante* cost assessments resulted in construction costs overrunning by 80%, and financing costs by 140%. The internal rate of return of the investment was negative at -14.5% (Flyvbjerg, 2009). In 2007, a restructuring plan was approved by the company's shareholders. A first dividend to shareholders was paid only in 2009, even though it had been promised in 1995 (*The Economist*, 2014). The main shareholders now are Goldman Sachs, Franklin Resources and Prudential, although 750,000 people still have small shareholdings.

Infrastructure projects are generally developed over four main stages (Beckers et al., 2013) (see Figure 4.1):

- *Selecting, planning and designing the underlying asset*, such as a bridge or a toll road. In this preliminary phase the assessment of risks and expected costs, the identification of the final users of the asset and calculation of the expected returns to the investment are crucial. Miscalculations and mistakes can lead to delays and waste of financial resources (and ultimately can cause the project to fail). There are several examples in Europe of projects whose costs were not correctly assessed. For instance, in the Netherlands, the 'Betuve' cargo rail system was delayed for 18 months and costs overran by €3 billion (over and above the original estimate of €2.3 billion). In most cases, the public sector still plays a strategic role at this stage, in deciding the pipeline of infrastructure investments.
- *Procurement and contractual design.* Contractors need to be selected and contracts written in order to share risks appropriately among the partners involved and to ensure that private and social interests do not clash (Estache et al., 2009). Risks are higher at the initial stages (WEF, 2013). Managing risks at the beginning of a project is thus crucial. Failure to allocate risks translates into unexpected cost increases. For instance, the construction of the Jubilee Line in the London Underground cost 42% more than initially planned, owing to mispricing of future risks. (Beckers et al., 2013). Procurement contracts therefore need to be transparent in attributing risk ownership and risk return.
- *Construction delivery.* At this point, contractual default and delays are the main sources of risk and, again, may lead to cost overruns.
- *Operation of the infrastructure asset.* Contractors are responsible for delivering on-time services to users. It

Figure 4.1: The life-cycle of infrastructure projects



Source: Authors' elaboration on PwC (2013b).

is the least risky stage, provided that the project has reached an efficient operating state. This is when a project becomes profitable. Monitoring is important in order to assess that the cash flows generated by the asset are in line with the initial forecasts (Weber and Alfen, 2010). Projects generate different revenue streams according to sectors. For instance, revenues of roads and airports are generated by charging users, while in the case of social infrastructure investors are directly remunerated by the public sector (generally through leasing contracts).

Managing and correctly pricing risks throughout the different phases of an infrastructure project is therefore also essential. There are specific risks for each different stage. Planning, technology and construction risks typically belong to the pre-completion phase and, if not correctly forecast, they may lead to costs overrun, delays and underperformance. Post-completion risks are generally less sharp, but problems can arise when the infrastructure begins to generate revenue. For instance, it is quite common to overestimate the number of users of, say, a toll road. In Australia, big infrastructure projects failed to predict the number of users accurately, with actual traffic at least 30–40% below forecasts (Locke, 2010). It is critical to correctly assess market demand risks, which are generally determined by external macroeconomic conditions that affect consumers' demand. To mitigate market demand risks, 'cap and floor' mechanisms can be adopted. These can protect both the investor and the consumer by preventing revenues from falling below or exceeding a certain threshold. A case in point, which is currently in a testing phase, is the electricity interconnectors between the UK and Belgium (Ofgem, 2014).

It is important to have in place a clear, transparent and stable regulatory framework in order to attract investors in infrastructure projects. This responsibility falls to the public sector, which has to provide the stability that allows investors to earn returns.

Political risk is usually the most difficult to handle. It often depends on governments' actions, including changes to laws and regulations, on social unrest, or on macroeconomic variables such as rapidly rising inflation or volatility in interest and exchange rates. Political risk is a feauture of many developing countries where institutional and economic conditions are more unstable. In Western countries and in the EU political risk is usually low, but investors are concerned about changes in the regulatory framework. It is therefore important to have in place a clear, transparent and stable regulatory framework in order to attract investors in infrastructure projects. This responsibility falls to the public sector, which has to provide the stability that allows investors to earn returns (Aghion et al., 2013). Public accountability can be a determinant in attracting investors to infrastructure. Lack of accountability tends to discourage investors and is a problem today in some EU states, particularly at the regional and local level.[21]

Financing infrastructure projects over their life-cycle

Different instruments are appropriate at different points of a project's life-cycle. In general, infrastructure projects offer stable cash flows that are relatively uncorrelated with the business cycle (Jones and Llewellyn, 2013). However, as risk decreases during the later stages, debt is used to meet financing needs.

At the outset of a project, the amount of capital required is usually relatively low – typically between 2% and 4% of the total financing required (WEF, 2013) – but fundraising can be problematic at this stage because of the higher risk. As noted above, mistakes made in feasibility studies can lead to difficulties and underperformance in the following stages of the project, increasing the difficulty in raising further financing (KPMG, 2010). Typically, capital is initially raised through equity offerings by the project sponsors, and in the later stages additional resources are raised via investment funds (including from institutional investors) (Weber and Alfen, 2010). Loans are generally obtained from the construction phase onwards, but small loans can be obtained also in the earlier stages (WEF, 2013). Therefore, the typical forms and sources of financing tend to change over time so as to match the different propensities for risk among investors.

At the early stage there tends to be a greater involvement of private equity funds, which are less risk-averse, while long-term investors, being more interested in the cash flow generated by a project, tend to join in later.

Development capital can also be obtained from government economic development schemes. National development banks can offer various forms of support for infrastructure projects (repayable grants, low-interest loans, subsidies).[22]

[21] See the case study on Italy presented in Chapter 2 (Box 2.6).

[22] Development banks are present not only in developing countries (for instance, the Brazilian Deveopment Bank – BNDES), but also in Europe. Examples are Cassa Depositi e Prestiti (CDP) in Italy, Kreditanstalt für Wiederaufbau (KfW) in Germany, Caisse des Dépôts et Consignations (CDC) in France, and Instituto de Crédito Oficial (ICO) in Spain. At the supranational level, the EIB and the European Bank for Reconstruction and Development (EBRD) are the most important ones. The rationale of development banks is to provide a fundamental complement to traditional sources of credit, aiming in particular to enable businesses to get access to long-term finance, especially for infrastructure projects (United Nations, 2005). Instruments often used by these banks are syndicated loans, equity and quasi-equity.

The increasing need for equity financing

In recent years, equity financing of infrastructure companies and assets has gained significant momentum, especially in Europe. From 2003 to 2011 the infrastructure securities market has grown by approximately 230%, especially in energy infrastructure, which required investment to renovate assets built during the second half of the last century (RREEF Infrastructure, 2011a).

Companies listed on public stock exchanges are the most sizeable owners of infrastructure assets. For these listed companies, capital raised on the stock market is a major source of private finance for infrastructure. Infrastructure stocks form a subset of global stock markets. RREEF Infrastructure (2011b) identified 535 infrastructure stocks with a market capitalization of $3.25 trillion worldwide. This is roughly 6% of the estimated global stock market capitalization in 2011, a percentage similar to that found by Standard & Poor's (Inderst, 2013). Between 2006 and 2011, about $36 billion of equity financing was raised globally, including $10 billion in Europe (Inderst, 2013).

Privatization has been a key driver of equity financing, especially in Europe. Since 1988 approximately $2.35 trillion of assets have been privatized around the world (of which 40% were privatized in the EU (RREEF Infrastructure, 2011b). A new wave of privatizations is expected across Europe, since Portugal and Spain are looking to privatize airport assets (RREEF Infrastructure, 2011b) and the UK is aiming to get private capital engaged in financing hospitals. Privatizations of government assets may continue to drive infrastructure Initial Public Offerings (IPOs) in Europe in future.

Loans and bonds

On average, bank loans (single or syndicated) for infrastructure projects have a maturity of 7–12 years (Weber and Alfen, 2010). This means that a single loan would not be sufficient to cover the financing needs of the whole life-cycle of a project, so later refinancing would be needed. In addition, as infrastructure projects are usually sizeable in terms of funding requirements,[23] often a loan from a single bank is not enough and syndicated loans are frequently arranged by a group (consortium) of banks (Weber and Alfen, 2010). Loan syndication as a project financing mechanism has been increasing at the global level, from $194 billion in 1992 to $2,666 billion. in 2007, but it fell back somewhat after the global financial crisis as overall bank lending was constrained (Twinamatsiko, 2009). Syndicated loans for infrastructure projects offer advantages for both companies and banks. Not only can they present an opportunity to mobilize more funds for the project managers, but also they allow banks to diversify risk through information-sharing. This can ultimately lead to a reduction in financing costs, with advantages for borrowers and potentially also for the final users of the infrastructure asset (Twinamatsiko, 2009).

Bonds are the other main form of debt financing. They are generally issued for large-scale projects (usually for projects of more than €100 million). Corporate bonds offer several advantages. First of all, their duration is on average much longer than bank loans (up to 50 years), making them a particularly stable and reliable source of long-term finance for non-financial companies. Bonds also have a fixed investment term, which can be set to match expected business cash flows (ICMA, 2013).

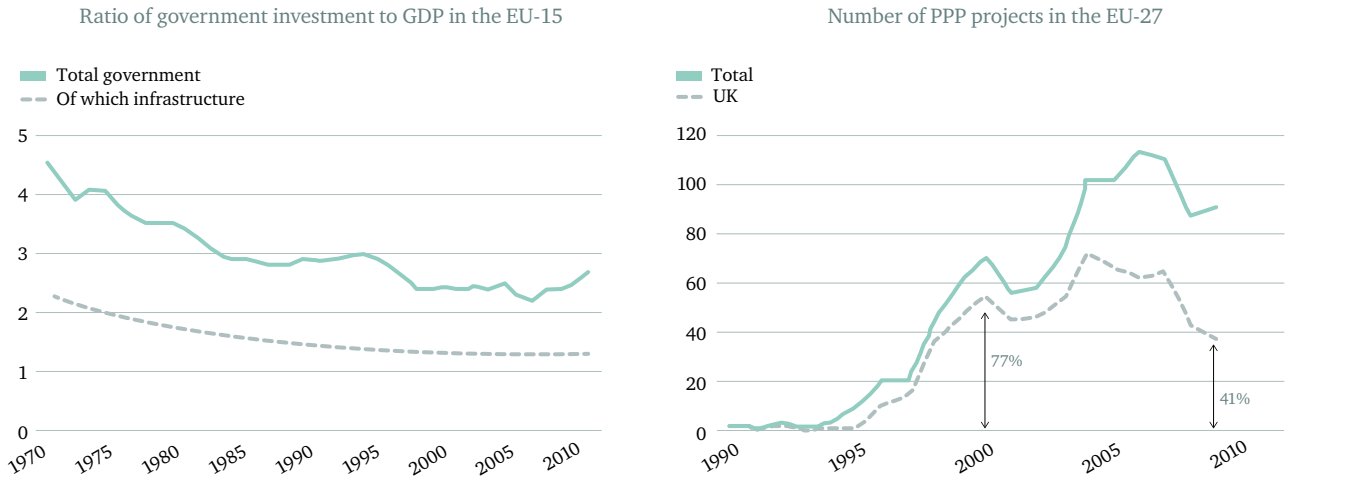
Corporate bonds have been used to finance infrastructure projects for a long time. For the construction of motorways in Italy in the 1960s, the issuance of a eurobond[24] was pioneered (Box 4.2). Today, infrastructure bonds are corporate bonds earmarked for specific infrastructure projects, e.g. to build a new tunnel. In the UK a new type of infrastructure bond has been developed recently in the form of PPP/PFI1 bonds (Inderst, 2010). These instruments offer several potential benefits – they are low-cost, long-duration and could be inflation-linked (Inderst, 2010). Moreover, infrastructure can generate higher yields than other asset classes (Jones and Llewellyn, 2013). For instance, bonds to a value of £304 million, offering a 4.1% interest rate, were bought in August 2013 to finance the installation of the cables from a wind farm off the Suffolk coast (Thompson, 2014).

Box 4.2: Autostrade Italiane and the creation of the eurobond market

On July 1, 1963, Autostrade per l'Italia, the operator of Italy's national system of motorways, issued the world's first eurobond in order to build its first toll road. It was a six-year, $15 million loan arranged by London bankers S G Warburg. Autostrade came back to the bond market 40 years later with a €6.5 billion offering to pay off bank loans and to finance a 10-year investment programme. This was the largest corporate bond offer in Europe in 2004. This product's success speaks for itself. In 1966 the market had grown to $1 billion, and it reached a peak of $4.5 trillion in 2009 (Atkins and Stothard, 2013).

[23] According to different sources (WEF, 2013; Weber and Alfen, 2010), most large-scale infrastructural projects usually cost between $100 and $500 million.
[24] The concept of 'eurobond' needs to be distinguished from the concept of euro-denominated bonds backed by all the euro area states. A eurobond is an international bond that is denominated in a currency not native to the country where it is issued – for example, euroyen and eurodollar bonds are denominated in Japanese yen and American dollars respectively.

Figure 4.2: Long-term evolution of public and private finance sources



Source: Wagenvoort et al., 2010.

The corporate bond market in Europe is still less developed than in the US (ICMA, 2013). Cross-border ownership of corporate bonds is also underdeveloped in the EU. The fragmentation of the EU financial market offers fewer opportunities for risk-sharing between European countries than is the case between US states (HLEG, 2013). However, bond issuance has been rising steadily, especially after the crisis in 2008–09. Companies are increasingly turning to bond issuance as a result of the credit squeeze in the banking sector. Also, investors are attracted to relatively high-yielding corporate bonds in the current environment, in which interest rates on government bonds have fallen to very low levels even in 'peripheral' euro area countries such as Portugal, Spain and Italy (Kaya and Meyer, 2013). The value of European investment-grade corporate bonds issued topped $20 billion in March 2014 (Bolger, 2014).

Today in Europe corporate (including infrastructure) bonds seem to offer an opportunity to infrastructure companies to access additional capital resources. However, there are constraints which prevent infrastructure businesses from seizing these opportunities fully. While corporate bonds are a complementary source of debt financing, they are not a perfect substitute for bank loans.

Fostering innovative financing models: the case for PPPs in the EU

What are public–private partnerships?

Collaboration between the public and the private sector offers a solution to the potential problems arising in the different stages of the delivery of an infrastructure project. Public–private partnerships (PPPs)[25] between the government and the private sector were introduced in the UK in the early 1990s to enhance the provision of public goods and services. Other European countries followed suit over the next ten years, leading to a significant rise in the number of PPP projects since the 2000s (Figure 4.2). Today the majority of PPP projects are delivered outside the UK.

At the beginning of 2000s, there was increasing interest in cooperation between the public and private sectors in developing and operating energy and transport infrastructure in Europe. This stemmed from the privatization of utilities, the development of large multi-national utility operators and a general review of how public spending should be undertaken to meet the Maastricht criteria (EC, 2003).

Among the various intermediate forms of infrastructure investment and provision that involve both the public and the private sector, PPPs stand out as the arrangement most commonly used in the last two decades to enable a government service or a private business venture to be funded through a partnership between these sectors. One key element is the transfer of a phase of the project to a private partner for a limited period of time. Unlike other forms of procurement, PPPs are characterized by a life-cycle approach. Private actors are involved not only in the construction stage, but also in the later phases of the project. This long-term relationship between the public and the private partners tends to generate efficiency gains through the use of private expertise and capital, and the transfer of risk to the private sector (Weber and Alfen, 2010). Under PPP arrangements, new infrastructure is mostly financed by the private sector, which helps alleviate

[25] Broadly, PPP refers to the arrangements between the public and private sectors, whereby some of the public services are provided by the private sector. A PPP sets out clear agreement on shared objectives for delivery of public infrastructure and/or public services (World Bank, 2012).

the financial burden on the public sector. Indeed, in today's context, PPPs are seen as essential schemes for cooperation between the public and the private sector.

Advantages and disadvantages

Engaging in PPP schemes also offers specific advantages to both sectors. First and foremost, governments can access additional funding and financing resources from the private sector so that project costs are not borne by taxpayers. In the EU, there is also a strong incentive for governments to take part in PPPs for budgetary reasons. If project risks are transferred to the private sector, infrastructure assets provided through a PPP are not classified as government assets and do not fall within the Maastricht criteria for deficit calculation (EPEC, 2010). Moreover, public services can benefit from improved operational efficiency, as PPPs enable private-sector technology and innovation to be introduced (World Bank, 2012).

For the private sector, one advantage is to access funding from the public sector at the project's initial stage, through either guarantees or subsidies. For instance, within the UK's Private Finance Initiative (PFI), projects received revenue support subsidy of £800 million annually (Whitfield, 2001). Moreover, the private sector is involved in the whole cycle of the project and not only in the construction phase. In this sense, PPPs offer long-term and usually stable investment opportunities, enabling private actors to maximize revenues, by increasing asset capacity and utilization or by setting and segmenting user prices (WEF, 2013).

PPPs also have some drawbacks. These projects are highly dependent on the political and financial commitments of the government. Their effectiveness is also often reduced by lack of transparency in the procurement procedure. Problems often occur during the construction phase where unexpected delays generate extra costs. And sometimes there is not enough transparency on the returns made by equity investors.

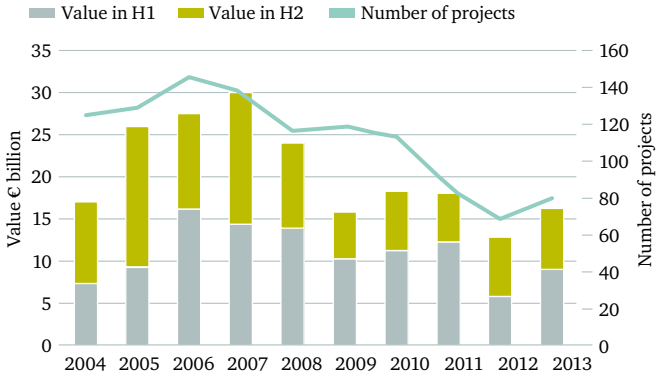
The implementation of PPPs in the EU: room for improvement

The importance of PPPs for investing in infrastructure is recognized at the EU level. In a Green Paper, the European Commission (EC, 2006a) highlighted them as a crucial element of risk-sharing between the public sector and private operators. With respect to infrastructure, the European Commission recognizes that PPPs could play an important role in the delivery of TENs projects in transport and energy. There has been a sharp increase in PPP projects in the EU since the early 1990s: from just two projects initiated in 1990 to 118 projects in 2009, in total 1,340 PPP projects have been launched with an overall value of over €250 billion. The UK is by far the leader in terms of numbers and aggregate value of PPP projects, accounting for 67.1% of total projects and 52.5% of total project value (Kappeler and Nemoz, 2010). However, PPP projects have been developed only in Greece, Portugal, the UK and, to some extent, Spain and Ireland. In all EU countries PPP investment flows represent less than 1% of GDP, while pure public investment is still quantitatively much larger (on average more than 3% of GDP) (EIB, 2010).

Given their dependence on governments' stability and political and financial commitments, the current active pipeline of PPP projects in Europe has slowly declined.

The global financial crisis precipitated a fall-off of investment generally, and hence PPP projects were also negatively affected. Given their dependence on governments' stability and political and financial commitments, as noted above, the current active pipeline of PPP projects in Europe has slowly declined. Data released by the EIB show that 2012 was a particularly difficult year: constrained public finances, lack of long-term debt financing and delays in procurement undermined the value of PPP investments and resulted in a fall in the number of deals (EPEC, 2014) (Figure 4.3). However, the EU represents the biggest region in the world in terms of such deals: in 2013 the aggregate value of PPP transactions which reached financial close[26] in the European market totalled €16.3 billion, a 27% increase on 2012 (EIB, 2014).

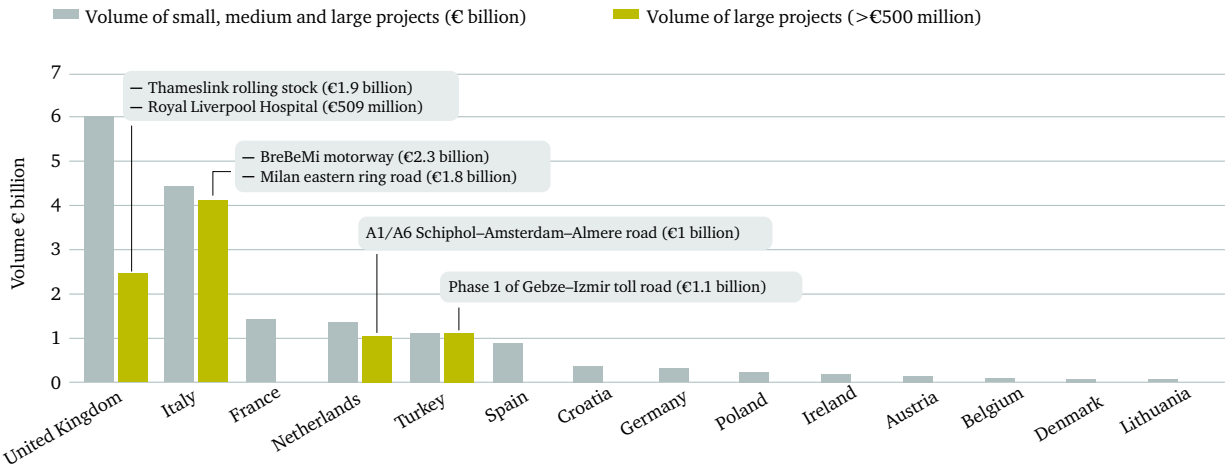
Figure 4.3: European PPP market by value (€ billion) and number of projects (2004–13)



Source: EIB, 2014.

[26] Financial close occurs when all the project and financing agreements have been signed and all the required conditions contained in them have been met. It enables funds (e.g. loans, equity, grants) to start flowing so that project implementation can actually start.

Figure 4.4: Location of large projects in 2013 (projects larger than €500 million)



Source: EIB, 2014.

In terms of sectors where PPP models were implemented, transport is still the largest, accounting for €9.6 billion, more than half the total value. Health care is rising in importance (the fastest-growing sector, with an aggregate value of €1.5 billion, a fourfold increase on 2012), while projects in social infrastructure (schools and hospitals) are the most important in terms of numbers (but not in value) (EIB, 2014).

The UK continues to lead PPP deals in Europe, in terms of both value and number of projects. In 2013, 31 transactions were closed (compared with 26 in 2012) with a value of about €6 billion (€5.6 billion in 2012) (Figure 4.4).

The biggest projects are the Thameslink rolling stock (€1.9 billion) and the Royal Liverpool Hospital (€509 million). In terms of value, Italy was the second largest PPP market (€4.4 billion). The biggest new projects are all concentrated in Lombardy (the BreBeMi motorway – €2.3 billion – and the Milan eastern ring road – €1.8 billion). Campania, located in Southern Italy, has the highest number of projects. This highlights once again the problem of the uneven distribution of infrastructure projects across regions in Europe.

5. Investors, Instruments and Coordinated Action

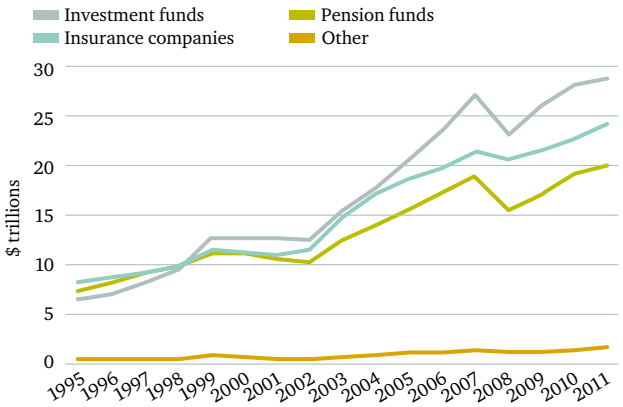
The potential role of institutional investors for infrastructure financing

Institutional investors[27] are becoming increasingly important players in global financial markets. The OECD (2014) reports institutional assets of $75 trillion at the end of 2010, including pension funds ($20.4 trillion), insurance companies ($24.3 trillion) and investment companies ($28.8 trillion) (Figure 5.1). In a wider calculation, global assets under management (AUM) have grown rapidly and reached $97 trillion at the end of 2012 (TheCityUK, 2013), equivalent to one year's global GDP, or around three-quarters of global banking-sector assets (Haldane, 2014).

The annual inflow of new funds is also substantial. For instance, pension funds collected about $1 trillion in new contributions in 2011. SWFs are also growing rapidly. Since 2002 their AUM have increased at an average annual rate of 16%, reaching $5,200 billion at the end of 2012 (Cassa Depositi e Prestiti, 2013). However, they still account for a limited share (5.2%) of total AUM (TheCityUK, 2013).

Pension funds and insurers are major investors in a large number of developed economies, with assets representing over 60% of GDP in countries such as Canada, the Netherlands, the United Kingdom and the United States. In the EU, the UK is the third biggest market in terms of pension funds and the fourth in terms of the ratio of pension funds to GDP (95.8%) (Della Croce and Yermo, 2013). The size of pension funds in terms of GDP is much lower in the rest of continental Europe, as these countries have traditionally relied more heavily on public pension schemes (Figure 5.1).

Figure 5.1: Total assets by type of institutional investors in the OECD (1995–2011, $ trillion)



Source: OECD, 2013.

Institutional investors are a reliable source of long-term capital, as they need to match their liabilities with long-maturity assets. This makes institutional investors particularly suitable to undertake counter-cyclical, long-term investments in sectors of the real economy characterized by high productivity and therefore able to generate stable streams of revenues. However, the widespread short-termism in current investment trends has also affected the investment decisions of institutional investors. In the years after the crisis, concerns about this trend have led to calls for more 'responsible' and longer-term investment by such investors (Ottesen, 2011; G30, 2013; WEF, 2011; EC, 2013a).

Institutional investors still tend to invest a limited share of their resources in infrastructure. Figure 5.2 shows that most of asset allocations of large pension funds go towards fixed income and cash (around 60%), listed equity (28%) or other alternative investments (15%), while a very residual part goes to unlisted infrastructure investment (1%). There are exceptions, however. Pension funds in Canada and Australia tend to invest much more heavily in both domestic and global infrastructure projects (see Box 5.1).

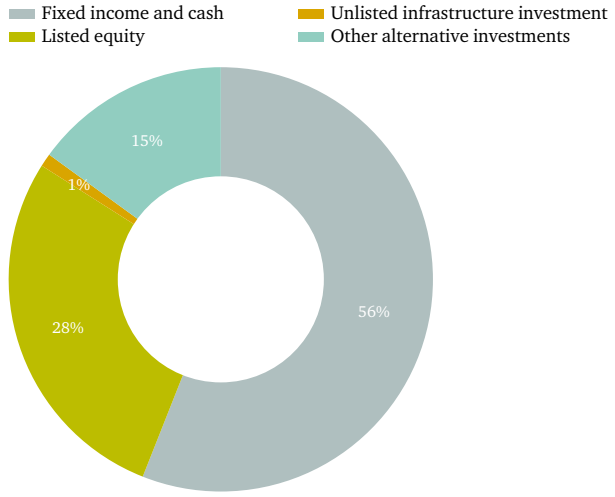
Box 5.1: Australian and Canadian pension funds as investors in infrastructure – examples to follow?

Canada and Australia are among the countries with the biggest private pension funds in the world. Ontario Teachers' Pension Plan Board is the largest pension fund in Canada, holding assets of $127.9 billion in 2012 (Inderst and Della Croce, 2013). Australian Super is the biggest Australian pension fund, with $54.6 billion of assets. These funds have been actively raising their investment in infrastructure over the last decade, with some now allocating as much as 10–15%. While Australia's pension funds are more focused on domestic infrastructure, Canada's are particularly active abroad and have shares in extremely sizeable projects such as London's airports and the Channel Tunnel (*The Economist*, 2012). Both countries are particularly attractive locations for institutional investors as their project bond markets are very well developed. Recently, big projects in Australia including the new Perth airport and the ConnectEast road were financed through the issuance of such bonds (PwC, 2013a).

Useful lessons to draw from Canada's case are the presence of an effective PPP and project bond market, which helps reduce reliance on bank credit. The Australian model shows that pension funds and other institutional investors can develop a high interest in privatized assets (Inderst and Della Croce, 2013).

[27] Institutional investors pool large sums of money and invest those sums in securities, property and other investment assets. They typically include insurance companies, retirement or pension funds, hedge funds, investment advisors and mutual funds. As they hold broad investment portfolios in different assets and countries, they allow spread risks.

Figure 5.2: Average asset allocation of large pension funds (2012)



Source: OECD, 2013.

Institutional investors have the potential to help address the EU's future 'infrastructure gap', as detailed in Chapter 3. In Europe, insurance and pension companies alone hold around €12 trillion of assets, equivalent to over 90% of EU GDP (Jones et al., 2014). Future EU investment needs in infrastructure are estimated at between €700 and €800 billion per year (Inderst and Della Croce, 2013), and it seems that institutional investors could make a significant contribution towards meeting them. However, their scope is currently constrained, with restrictions on cross-border activities and on investments in non-listed assets.

New financial instruments and vehicles

In order to improve the equilibrium level between the supply and demand for long-term financing of infrastructure projects, it is worth exploring what types of instruments and vehicles could help to address the investment shortfall in Europe and to increase the involvement of institutional investors in financing infrastructure.

Project bonds: strategies to improve their usage

One existing instrument which could be exploited further is project bonds. These are corporate bonds issued by a Special Purpose Vehicle (SPV), a new entity created specifically for one project by its sponsors. Project bonds have several advantages. They can reduce the financial burden on the public sector by involving private investors. They can also be more attractive to investors as they allow risks to be identified more clearly and the economic viability of a specific project to be assessed more easily. Project bonds are also particularly attractive to financial investors. Recent transactions for long-dated project bonds offered yields of between 5% and 6.5%. This is still considerably more attractive than the 4–5% yields available on sovereign bonds with equivalent ratings (S&P, 2013). However, potential drawbacks need to be carefully addressed. Issuing project bonds requires that risks, costs and expected revenues of the underlying project are accurately estimated from the very beginning, in order to reduce default risks.

Europe is still making marginal use of project bonds while other actors, such as Canada and Australia (see Box 5.1) have a much more developed project bond market. The EU's low reliance on project bonds does not stem from insufficient demand. Many investors (life insurers, for example) are reserving ever greater sums for this type of investment (Natixis, 2013). Issuance of project bonds is rising rapidly in Europe. In 2013, EU deals represented 30% of the global total of $35.6 billion (compared with just 4% in 2012) (Krouse, 2013). The UK is particularly active in this market and 40 new projects raising finance through project bonds were launched in 2013. This upward trend seems to point to a shift from bank credit to alternative sources of debt financing for infrastructure.

Issuance of project bonds is rising rapidly in Europe. In 2013, EU deals represented 30% of the global total of $35.6 billion (compared with just 4% in 2012). The UK is particularly active in this market and 40 new projects raising finance through project bonds were launched in 2013.

Currently, the EU 2020 Project Bond Initiative, undertaken by the European Investment Bank, is the most important strategy at the European level aiming to promote a more intense usage of project bonds for infrastructure. This scheme, now in its pilot phase (see Box 5.2), represents an interesting attempt to overcome stumbling blocks in the financing process, helping SPVs to get access to resources offering public support at the start of a project, where risks are higher and hence it is more difficult to raise financing.[28]

[28] See Chapter 4 for a detailed explanation.

Box 5.2: The EU 2020 Project Bond Initiative

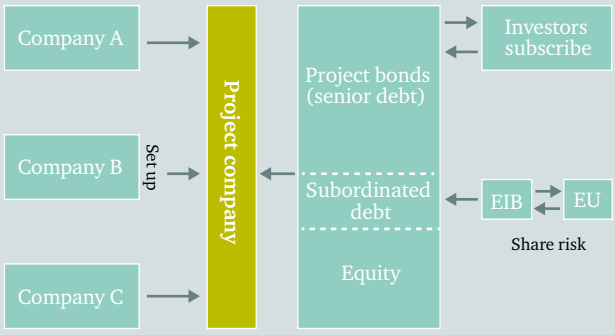
The EU 2020 Project Bond Initiative (PBI) aims to improve the credit quality of companies investing in infrastructure projects within the TENs framework. These bonds are issued by the sponsoring companies, usually through an SPV, and the facilitating role of the EIB is to provide credit enhancement in the form of a subordinated instrument (either a loan or a contingent facility) to support the senior debt issued by the project company (EIB, 2012a). For infrastructure project finance specifically, the first transaction under the EU/EIB PBI was a €200 million liquidity line as credit enhancement for the Castor underground gas storage project in Spain. Instead of using traditional bank lending, the project company raises the senior debt through project bond issues (see diagram below).

In the pilot phase of the Europe 2020 PBI, the EIB will provide a loan or guarantee (an EIB facility) to the project company in order to raise the likelihood of timely repayment of principal and interest to bond-holders during the lifetime of the bonds (thereby reducing the risk and, consequently increasing the credit rating of such bonds) (EIB, 2012b).

The senior tranche is provided by private institutional investors, while the subordinated tranche is provided by the EIB in the form of a Project Bonds Credit Enhancement (PBCE), which may not exceed 20% of the total project value.

Funding under the PBI has been modest in the pilot phase so far. However, €750 million could be potentially be made available in the period 2014–20, mobilizing €4.6 billion from institutional investors (Heymann, 2013).

How the EU 2020 Project Bond Initiative works



Sources: European Commission, EIB, DB Research schematic interpretation.

Loans: involving institutional investors

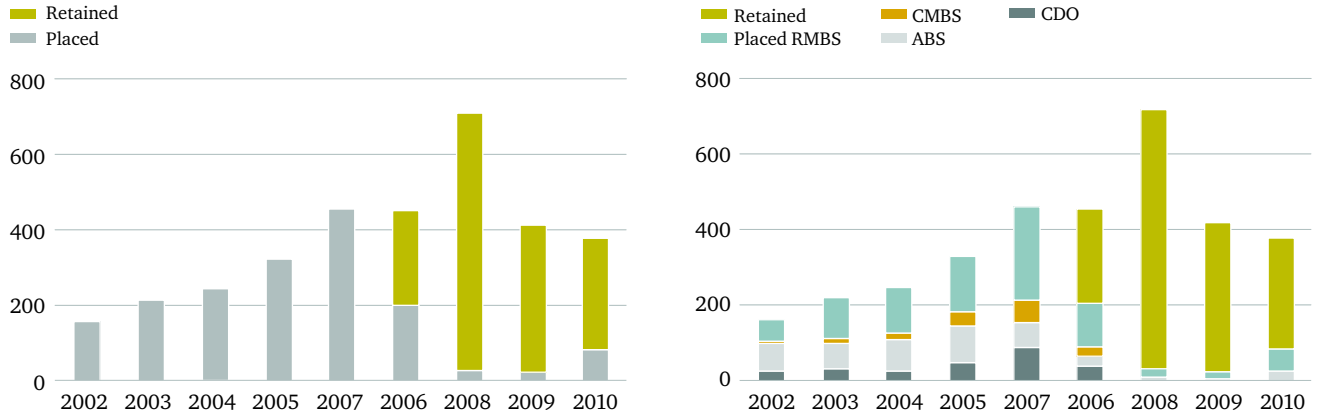
In recent years, a new trend in the structure of syndicated loans has become evident, with institutional investors becoming increasingly involved alongside banks in providing capital. To give an example, in the PPP market across Europe institutional investors were involved in 16 transactions completed in 2013. This represents 20% of the total number of deals and corresponds to a capital provision of €3.5 billion at very long maturities (loans with an average of 30 years and peak of 45 years) (EPEC, 2014). This innovative use of syndicated loans can take the form of a co-investment partnership, which institutionalizes the relationship between a bank and one or more institutional investors, in order to build up a portfolio of projects to finance. Alternatively, loans involving banks and institutional investors can take place on a deal-by-deal basis. Insurance companies, in particular, seem prepared to invest in this way, as they can finance long-tem projects and take advantage of the traditional expertise of banks in managing complex infrastructure projects (Bearing Point Institute, 2014).

Financing opportunities from the secondary market: securitization

The secondary capital market can be tapped in order to find additional financing sources for infrastructure projects. Investors' interest in the secondary market continues to recover on a global scale. According to the company Preqin (Lee, 2012), Europe-based institutions currently represent 48% of all investors looking to sell off private equity or real-estate fund stakes on the secondary market. Most of them (34%) are based in the UK, followed by Germany (17%).

In the secondary markets, securitization has traditionally offered banks a key source of long-term funding. Investors benefit from securitization as it increases the availability of credit while decreasing its cost, and allows them to gain direct risk exposure to diversified sectors of the economy (Blommestein et al., 2011). In the EU, the recovery of the securitization market after the financial crisis is still weak (Figure 5.3). There are problems both on both the supply side, as deteriorating macroeconomic conditions have depressed the issuance of loans, and the demand side, where the engagement of private investors has been weak. This has been partly compensated by the more active role of public institutions (see Box 5.3) in the securitization markets (ECB, 2011). Currently the United Kingdom, the Netherlands, Spain and Italy are the main issuers of securitized products in Europe (Blommestein et al., 2011).

Figure 5.3: European securitization issuance (2002–10, € billion)



Source: ECB, 2011.

Box 5.3: How to get additional financing for infrastructure: the case of securitization

Companies (or governments) which have to manage and maintain an infrastructure asset often need additional financing to fund the project throughout its entire life-cycle, once it is operational. But they struggle to get access to financing because of barriers in capital markets. Securitization can help remove these constraints. After a project has been completed and is performing satisfactorily, a Special Purpose Vehicle (SPV) can be created to issue debt and equity securities and use the proceeds to purchase infrastructure loans from the original lender. This allows the project to obtain alternative financing sources without any impact on the originator's balance sheet. The new assets are issued by the SPV, so that the originator's debt-to-equity ratio is reduced, potentially enabling it to borrow more in the future (Slaughter and May, 2010).

For instance, the public electricity provider in Portugal, EDP, made use of securitization in order to finance its so-called tariff deficit (the amount the state pays energy producers to make up the difference between the real cost of supplying energy and the prices consumers pay) (Wise, 2013). Securitization helped the Portuguese government to raise €450 million through issuing bonds, even though neither EDP nor the Portuguese government had investment-grade credit ratings. Moreover, this was achieved without any impact on the public budget. This was the largest public securitization in Portugal since the beginning of the financial crisis (StormHarbour Securities, 2014).

Nevertheless, there are potential drawbacks. Securitization of infrastructure projects can weaken the incentives for efficient operation created by bundling construction, operation and maintenance, so some governments place limits on the share of projects that can be sold in this way.

A new instrument: eurobonds for infrastructure?

Can the public sector find new ways to provide additional capital for infrastructure projects? An instrument that might be worth exploring is euro-denominated bonds with long maturities issued jointly at the EU level with the specific purpose of financing infrastructure. The European Commission currently borrows only to finance stabilization programmes such as the European Financial Stability Mechanism, Balance of Payments Assistance and Macro-Financial Assistance. The debt issued by the EU is backed by several layers of debt-service protection: the bond is fully guaranteed by the EU budget (€135.5 billion in payment appropriations for 2014) and, ultimately, by the EU member states (EC, 2014d). These bonds enjoy the highest investor-grade rating, given that they are guaranteed by all 28 member states. If a beneficiary country were to default, the debt would be serviced by the EU's budget.

The proposal to issue eurobonds with the purpose of mutualizing debt has been discussed for some years, and has generated a heated political debate. Two main proposals have been put forward so far. The Juncker and Tremonti proposal(Juncker and Tremonti, 2010) is based on the creation of a new institution, the European Debt Agency (EDA), which would pool national debt up to 40% of GDP. The Delpla-von Weizsäcker proposal (2011) is more elaborate. It is aimed at promoting fiscal discipline. Governments could issue 'blue bonds' up to 60% of GDP, which would be mutualized, and 'red bonds', which would be strictly national (Delpla and von Weizsäcker, 2011; European Parliament, Directorate General for Internal Policies, 2011).

The EU is still very far from issuing proper 'eurobonds'. Hence, a second-best option, which would start to prepare the ground for their proper issuance, could be that some states, or the European Investment Bank jointly with

national development banks[29] of sovereign countries in the euro area, start issuing bonds jointly. These would be transnational and, as suggested by Subacchi and Rossi (2006), would both generate stable financial returns for institutional investors such as pension subscribers and provide capital for long-term infrastucture projects aimed at enhancing economic growth in the real economy.

The coordinated action of national development banks

In Europe, the role of national development banks (see Box 5.4) has become very important in providing additional support for financing infrastructure projects. In the EU there are several public, or semi-public, development banks, which facilitate the provision of subsidies or loans. For instance, Kreditanstalt für Wiederaufbau (KfW) in Germany provides low-interest, long-term loans (20–30 years) for infrastructure projects with fixed interest rates and a maximum of between three and five repayment-free start-up years (Weber and Alfen, 2010). In Italy, Cassa Depositi e Prestiti (CDP) provides either direct financial support for key domestic infrastructure projects through loans, or indirect support through investments in infrastructure funds (Cassa Depositi e Prestiti, 2014). At the EU level, the EIB raises substantial volumes of funds on the capital markets and lends them on favourable terms. It does not provide subsidies, but only extends loans, guaranteeing AAA ratings.

Box 5.4: Joint initiatives of national development banks in Europe: the Marguerite Fund

The Marguerite Fund, or 'Marguerite: the 2020 European Fund for Energy, Climate Change and Infrastructure', is an example of coordinated action at the EU level. It was created in December 2008 by the European Council and backed by Cassa Depositi e Prestiti (CDP), Caisse des Dépôts et Consignations (CDC), the European Investment Bank (EIB) and KfW Bankengruppe (KfW). The European Commission, which endorsed the project from the outset, joined the project with an equity stake. It was followed by Instituto de Crédito Oficial (ICO) of Spain and PKO Bank Polski (PKO) of Poland, which took the number of founders to seven. It is estimated that during the next few years, the €1.5 billion Marguerite Fund will trigger and mobilize investment of about €30–50 billion in the European energy and infrastructure sectors (especially greenfield projects).

Examples of projects financed by the Marguerite Fund are a wind farm in Germany and the A1 motorway in Spain. The latter is a brownfield investment and consists of an equity investment of €60 million. It marked the first investment in the transport sector by the Marguerite Fund.

National development banks have recently started to coordinate their efforts on financing infrastructure projects in Europe (see Box 5.4).

The need for a holistic approach to financing infrastructure

This chapter has argued that there is a need to increase the financing available for long-term capital investment, and to stimulate the number of infrastructure projects. In the current financial situation, liquidity appears not to be an issue, but there are several constraints on the availability of long-term financing. Challenges are currently posed by an unfavourable financial regulatory framework, limited financing instruments and restrictions on institutional investors' portfolio allocation.

A more intense and effective use of project bonds, as well as strategies such as securitization, can help fill the financing 'gaps' in different phases of projects.

Europe needs an infrastructure policy that eases these constraints. Scarce financing resources need to be used efficiently, removing bottlenecks in long-term financing, and clearly identifying the most appropriate instruments and vehicles at each stage of the life-cycle of an infrastructure project. A more intensive and effective use of project bonds, as well as strategies such as securitization, can help fill the financing 'gaps' in different phases of projects. Exploring the opportunity to issue eurobonds to finance infrastructure projects by the member states of the euro area would allow the public sector to retain a role in the provision of infrastructure. Such instruments would also have the potential to attract institutional investors, especially pension funds, which will be increasingly looking for long-dated assets to repay their subscribers. Of course these instruments need to price the underlying risk appropriately. A sovereign guaranteed infrastructure bond does not have special value or appeal for investors, particularly if it is less liquid than government bonds. Moreover, the issue of increasing sovereign debt levels should be considered very carefully, especially in the EU context where the rules of the Fiscal Compact will force many countries to reduce their debt-to-GDP ratio progressively.

Institutional investors have the potential to cover much of the EU's future investment needs in infrastructure. These institutions, especially pension funds, are expected to play a bigger role in the EU in the medium to long term. Demographic changes and the need for these investors to match their liabilities with relatively safe long-maturity assets are likely to open a window of opportunity and could make available additional resources for infrastructure projects.

[29] CDP in Italy, CPC in France, KfW in Germany, ICO in Spain.

6. Conclusion

Revamping investment and promoting infrastructure projects, particularly large pan-European ones, are key to stronger economic activity, better productivity growth and robust job creation. In this report we show that there are potential synergies between the demand for infrastructure, which is due to grow in the next decade, and the supply of capital in search of steady revenues over several years to match Europe's demographic profile – and the liabilities of many pension funds. More and better investment in infrastructure can boost domestic demand, especially in the early phases of projects. And if this investment is planned and managed well, it can also have important supply-side benefits. The challenge is to devise incentives for both the public and private sectors to realize these benefits with the help of innovative financing.

Institutional investors such as pension funds are a natural fit for long-term investment given their time horizon and their need to generate steady revenues over several years. However, they currently invest a limited share of their resources in infrastructure and most of their asset allocations go towards fixed income and cash, listed equity and other alternative investments. Only a very residual part goes to unlisted infrastructure investment. There is frustration on both sides. Institutional investors would like to see more investment opportunities, and public–private consortiums complain that investors require too many guarantees before taking on risk. It is a case of mutual misunderstanding.

The question is therefore how to match the demand for investment in infrastructure with the financial resources that are currently available. In this report we argue that infrastructure projects need an innovative approach, in terms both of policies and of financial instruments.

Learning from past mistakes of too many ill-conceived, badly implemented and over-spent infrastructure projects, the report stresses the importance of choosing projects that are likely to deliver good returns. Risks, in particular political risk, should be carefully assessed, and due diligence over the life-cycle of a project should be in place. And it is critical to ensure that only the best projects will obtain finance, especially in the case of public funds such as EU Structural and Cohesion Funds.

Considering other sources of funding than bank loans is also important. Traditionally projects have been funded by banks, but European banks are constrained. They are still dealing with the effects of the financial crisis and still repairing their balance-sheets, scaling back infrastructure loans, and shifting to lending for projects with shorter maturities. In addition, the new 'Basel III' rules are steering banks away from the long-term loans required by backers of infrastructure projects. In recent years, equity financing of infrastructure companies and assets has gained significant momentum, especially in Europe. But Europe, especially the euro area, trails behind the United States in fundraising for infrastructure projects on the capital market. More needs to be done, therefore, in order to develop a liquid and diversified capital market in Europe.

Effective collaboration between the private and the public sector is critical. The report shows that often the private sector does not have the right incentives to step in. Indeed negative externalities, high risks and the existence of a 'grey area' where accountability is unclear are all typical problems related to infrastructure projects. Moreover, infrastructure projects generally require long-term commitments in terms of investment, and the private sector is often not willing to take on these risks and even to be the guarantor of the investment if things go wrong. The report looks at cases where the public sector could help mitigate risks which do not depend on a project's intrinsic features. For instance, mechanisms of 'cap and floor' described in Chapter 3 can help smooth demand risks in the management of network infrastructure (especially electricity and telecommunications).

Large projects generate positive spillovers in terms of job creation and productivity growth that transcend national borders. They are *de facto* pan-European because they employ materials, technology, machinery and people from different countries. In the report we advocate the promotion of pan-European infrastructure projects that cut across borders.

In addition we suggest that the EU and its member governments should pick up the tab and launch projects financed by jointly issued eurobonds. The return on well-selected and well-managed infrastructure projects is certainly higher than the current low return on risk-free financial instruments in an environment of abundant liquidity and under-utilized resources. If economic actors, both public and private, can be encouraged to take advantage of current conditions – where finance is relatively cheap and real resources relatively plentiful – to increase investment in infrastructure, this can create a virtuous circle and kick-start growth.

Appendix: High-tech Infrastructure

Infrastructure is a very broad concept. It involves not only 'traditional' assets such as roads and railways, but also more technology-intensive assets including broadband networks, navigation and positioning systems, earth observation and monitoring systems. Technology-intensive infrastructure can create positive effects for both publicly and privately managed assets. Two examples of hi-tech infrastructure are:

- **satellites and space facilities:** these have become increasingly important, as many activities and services depend on them. They currently represent the highest end of high-tech infrastructure. Among the elements are air and sea traffic control, unmanned aerial vehicle (UAV) operations, goods tracking, TV and radio signal distribution, timing and synchronization, environmental monitoring, weather forecasting, agricultural compliance, power grid coordination, mineral and oil detection, telemedicine, and search and rescue.
- **interdependence between space and cyber-space:** these types of infrastructure open up the possibility of interconnections between physical and IT infrastructure. They are needed because of the unprecedented level of data and space-enabled services. Satellite integrated systems can have very positive impacts on agricultural efficiency and disaster relief planning. Space and cyber-space can also generate positive network externalities and improve the level of interconnectedness between individuals and other infrastructure assets.

Investing in space infrastructure could create high value added in related services, but it needs long-term investment since space systems and satellite constellations have a long service life. This is already an expanding market. For instance, the satellite industry nearly doubled in terms of revenues, from $106 billion in 2006 to $177 billion in 2011 (Finmeccanica, 2014).

Another high-tech sector is 'smart solutions', which incorporate efficiency-enhancing devices and applications in air traffic management, transport, health and wellbeing security, logistics and energy. Smart solutions increase the degree of technology and innovation in many different types of infrastructure, and can enhance security, flexibility and sustainability. One example of this is the DiBOSS project (Digital Building Operating System), developed by Finmeccanica and Columbia University, and successfully applied by a private operator in some skyscrapers in Manhattan. This provides buildings with a 'brain' (machine learning algorithms) allowing the infrastructure to 'learn' from the behaviour of plants, equipment and people living in the building and enabling improvements in efficiency, security and environmental standards. This system also allows buildings to interact with the rest of the urban networks, forecasting external events and fostering energy-saving through integration with urban energy systems.

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