Infrastructure in Greece

Funding the future

May 2019
The investment gap in Greek infrastructure is about 0.7pp of GDP.
Executive Summary
Executive Summary (1/2)

Funding the future

- Global infrastructure needs are expected to reach around $80tn by 2040
- Greece ranks 38th globally and 21st among the EU countries in terms of infrastructure
- There is an infrastructure investment gap between 0.7pp of GDP (against the European average) translating into an average spending shortage of €1.4bn per year
- Infrastructure investments have an economic multiplier of 1.8x, which boosts demand across the economy
- The infrastructure pipeline, i.e. projects in progress or prepared but not yet funded, amounts to 88 projects with a budget of €25bn
- The pipeline is higher than in the past due to the completion of lower cost projects and the addition of higher cost ones in the preparation phase
- €10.6bn of the budget refers to Energy projects, while €7.4bn to Railways and €4.3bn to Motorways. Tourist infrastructure and Waste management projects account for a small part of the remaining budget taking up only about €1.3bn and €0.9bn respectively
- The infrastructure pipeline is concentrated (63%) on electricity interconnection and generation and urban rail
- The current project portfolio is heavy on energy and transport but short on connectivity, tourism and the environment

€25bn total infrastructure budget

Infrastructure work in progress and upcoming projects

Source: Press, PwC calculations
Infrastructure projects in Greece suffer from systematic slippage both in preparation and execution, with an average 23 months of slippage in preparation/design and 28 months of slippage in execution/construction. Possible delay factors range from government and contractor issues to general and environmental problems.

Possible delays in execution will lead to a loss of investment of around €4bn by 2024 with a 0.8pp p.a. negative impact on GDP, which makes more imperative for the government to move the backlog of €8.2bn, in the planning stage, forward.

There should be a single state organisation mandated with the planning, design and management of all major infrastructure projects to reduce delays and maximise private funding.

Accelerating the preparation of projects and minimizing slippage requires better coordination across the whole process and full use of concessionary and private funding.

The growing need for infrastructure spending, combined with the limited capacity of state funding and the balance sheet constraints of the Greek banks call for new sources of funding. Traditional funding sources, such as loan facilities and the Public Investment Program are limited, shifting the financing focus to the private sector.
2 Infrastructure investment
Definition of infrastructure

• “Infrastructure is the system of public works in a country, state or region, including roads, utility lines and public buildings”
  OECD
• “Infrastructure is “the basic framework for delivering energy, transport, water & sanitation and information & communication technology (ICT) services to people affecting directly or indirectly their lives”
  World Bank

In the study, we have included projects with regards to transport (airport, ports, roads & rail), energy (electricity, oil & gas) as well as water & sewage, whilst ICT and Social Infrastructure (e.g. Hospitals, Schools, Public Buildings, Sport Structures and Green Areas) have been excluded.

Information & Communications Technology, according to the World Bank, refers to physical telecommunications systems and networks (cellar, broadcast, cable, satellite, postal) and the services that utilize them (internet, voice, mail, radio, and television).
Sustainable Development Goals (SDGs)
17 SDGs focusing mainly on 6 investment areas addressing poverty and universal development

In 2015, 193 UN Member States adopted the Sustainable Development Goals (SDGs) to be achieved by 2030 in order to build sustainable economic growth

**Investment areas**

1. Health
2. Education
3. Social Protection
4. Food Security and Sustainable Agriculture
5. Infrastructure
6. Ecosystem Services

In the long-term, infrastructure investment can jolt economic growth by increasing the potential supply capacity of an economy

Source: Transforming our world: the 2030 Agenda for Sustainable Development, UN, 2015
Source: Investment Needs to Achieve the Sustainable Development Goals, UN, 2015
Global infrastructure could require up to $80tn of investment by 2040

In the period 2018-2040, **3.2% of global GDP** needs to be invested in water infrastructure, road & rail transportation, airports and ports, energy. **Traditional funding sources are no longer enough** to cover the rapid increase in infrastructure projects, which are expected to reach $3.5tn p.a. until 2040.

**Transport**
- Road: 31.6
- Rail: 10.6
- Airports & Ports: 4.6

**Infrastructure needs ($trln)**
- Water: 6.0
- Transport: 46.8
- Energy*: 26.7
- Total: 79.6

% of Global GDP
- Water: 0.2%
- Transport: 1.9%
- Energy*: 1.1%
- Total: 79.6%

*Source: Global Infrastructure Outlook, Oxford Economics*
Infrastructure extent and quality index
Greece ranks low relatively to its global peers

The infrastructure index captures the quality and extent of transport and utility infrastructure.

**Transport Infrastructure**

I. Road
- Quality of road network
- Quality of road infrastructure

II. Rail
- Railroad density
- Efficiency of train services

III. Air
- Airport connectivity
- Efficiency of transport services

IV. Sea
- Shipping connectivity***
- Efficiency of seaport services

**Utility Infrastructure**

I. Electricity
- Electricity access
- Electricity quality

II. Water
- Exposure to unsafe drinking water
- Reliability of water supply

*** For landlocked countries, this indicator is not included in the computation and the Sea component score only corresponds to the score of “Efficiency of seaport services”

Source: The Global Competitiveness Report 2018
* Indices are expressed on a 0 to 100 scale and are interpreted as “progress scores”, indicating how close a country is to the ideal state

Ranking in infrastructure (140 countries)

<table>
<thead>
<tr>
<th>Best performer (1st)</th>
<th>Singapore</th>
<th>Singapore</th>
<th>Switzerland</th>
<th>Japan</th>
<th>Singapore</th>
<th>6 countries**</th>
<th>Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>38th</td>
<td>49th</td>
<td>49th</td>
<td>26th</td>
<td>30th</td>
<td>47th</td>
<td>31st</td>
</tr>
</tbody>
</table>

**Finland, Hong Kong, Iceland, South Korea, Luxembourg, Singapore

PwC

May 2019
There are two statistically distinct levels of infrastructure extent and quality, whose difference cannot be explained by the level of GDP.

**Greece ranks 38th globally and 21st among the EU countries in terms of infrastructure, revealing also a quality gap for the current level of GDP per capita.**

The differences in infrastructure extent and quality between Western and Northern European countries, compared to the Central and Eastern European countries, cannot be explained by the level of relative investment. Infrastructure investments, measured through the Gross Fixed Capital Formation (GFCF), appear to have a different impact on infrastructure quality in each group.

In **Greece**, the average infrastructure investment level during 2009-2018 corresponded to only 14% of GDP, **lowest among all E.U. countries**, undermining country’s upcoming infrastructure quality.

**Source:** World Economic Forum - The Global Competitiveness Report 2018, BMI.
There is a systematic investment gap of 0.7 pps of GDP (or ca. €1.4bn p.a.) in Greek infrastructure over the past 10 years

Infrastructure in Greece has been severely affected by the deep recession. Total value of infrastructure projects has decreased by as much as 29% after 2009 but has rebounded since

The current rate of infrastructure investment is around 1.4% of GDP, falling short of the historical pre-crisis average of 3.0% and the European average of 2.1% of GDP

The erosion of infrastructure investment from 2009 to 2018 resulted in a €13bn permanent shortage** against the EU average

The infrastructure investment gap is between 0.7 pp of GDP (against the European average) or 1.6 pp of GDP (against pre-crisis levels)

Infrastructure investments in Greece have an economic multiplier of around 1.8x***. The industry employs ca 875k people

---

**for every Euro spent on infrastructure, GDP is further increased by €0.8 (IMF Working paper “The welfare multiplier of Public Infrastructure Investment, 2016)
There is need for more investment in infrastructure

- There is a large need for further infrastructure investment globally over the next 22 years, estimated at $3.5trln per annum or 3.2% of global GDP
- The average annual level of infrastructure investment in Greece between 2009 and 2018 stands at €2.6bn, 54% lower than the historical average of 2000-2008
- In Greece, there is a systematic infrastructure investment gap of 0.7pps of GDP (ca. €1.4bn p.a.) or about €12.6bn in total, over the past 10 years
- The quality of infrastructure in Greece is substantially inferior than the level of wealth would predict
- The need for infrastructure investments in Greece in terms of both capacity expansion and quality improvement is evident
3

Greek

infrastructure

projects

pipeline
Between 2014 and 2018, 35 infrastructure projects were completed totaling €8.3bn

Budget of completed projects (2014-2018)

- Motorway Projects
- Water & Sewage
- Energy Projects
- Energy Interconnection Projects
- Rail Projects
- Tourist product upgrading

Source: Press, PwC calculations

Number of completed projects

2014: 2
2015: 4
2016: 6
2017: 14
2018: 9

Source: Press, PwC calculations
Infrastructure projects pipeline amount to €25bn

Most of energy and rail projects are in progress, 5 waste management projects are about to be delivered, while tourist product projects are still in initial development stage.

Rail, energy and motorways require higher investment per project, compared to tourist infrastructure and waste management projects.

Pipeline budget* breakdown

33% of the pipeline budget represents projects that have already commenced.

15% of the projects, with a remaining budget of around €0.5bn, are estimated to be delivered in 2019.

The commencement/completion dates of 32 projects in early planning phase, with a €8.2bn budget, are unknown.

Estimated Completion year (cumulative)

32 projects are in early design phase with no announced commencement and completion dates yet.

Source: Press, PwC calculations

*Infrastructure projects backlog and total budget of upcoming projects
Higher infrastructure pipeline mainly due to completion of lower cost projects and addition of higher cost new ones in the preparation phase.

Evolution of 5-year infrastructure pipeline (2014-2018)

From 2014 to 2016 the work in progress investment remained fairly stable but in 2017 and 2018 dropped due to completion of a number of projects and no new commencements.

Source: PwC calculations

Infrastructure in Greece 2018
PwC
Energy and urban rail projects account for 63% of the total budget

- Waste management and water supply get very little attention
- Rail, given its current low economic significance, gets a disproportionate share (10.4%)

### Subsector & project budget

- There are 19 Energy projects (43% of total pipeline budget) mainly in oil & gas and electricity
- 30% of the remaining budget covers rail projects (17 projects), while 18% (13 projects) motorways
Energy projects amount to ca. € 10.6bn

- 63% of the number of energy projects are **interconnections** (TAP, IGB, EuroAsia, Ariadne, LNGs), while the remaining 37% refers to **electricity generation** (Wind parks, Power plants)
- 62% of the remaining budget is earmarked for energy interconnections and the rest for electricity generation
- **Almost half of the total energy projects have not yet started**

**Estimated Completion year (cumulative)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>1</td>
</tr>
<tr>
<td>2020</td>
<td>5</td>
</tr>
<tr>
<td>2021</td>
<td>7</td>
</tr>
<tr>
<td>2022</td>
<td>7</td>
</tr>
<tr>
<td>2023</td>
<td>13</td>
</tr>
</tbody>
</table>

**Number of projects with no announced commencement/ completion dates**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Electricity interconnection projects account for 40% of the budget and generation for 38%

- The electricity interconnectors take up about 40% of the outstanding budget
- About 67% of the total remaining budget of scheduled electricity generation projects refers to **renewable energy** and in particular wind
- The average cost per new MW installed is about € 1.1mn

### Energy projects
Remaining budget 2018 (€ bn)

- Gas Interconnectors (TAP/IGB): 1,213
- Electricity Interconnectors: 4,260
- Electricity generation: 4,023
- LNG terminals: 655
- Other: 437

### Electricity generation sources
% of remaining budget 2018

- Fuel/Lignite: 12.5%
- Wind: 42.8%
- Hybrid (Hydro & Wind): 33.0%
- Solar: 7.0%
- Hydro: 4.7%

**Source:** Press, PwC calculations
Energy projects geographical distribution

- **Trans-Adriatic Pipeline**: of 878 km in total will supply Europe with natural gas from Azerbaijan through Greece, Albania and Italy, with a capacity of 20 bn m³ per annum.

- **Ptolemaida V Power Plant**: New single lignite power plant of 660 MW and 140 MW for district heating (PPC).

- **Attica – Crete and Peloponnese – Crete Interconnectors**: 310 km underwater electric cable connecting Crete with mainland with a capacity of 1,000 MW and 400MW respectively.

- **IGB**: Natural gas pipeline of 182km length will connect the Greek and Bulgarian existing networks, with daily transport capacity of approximately 3-5bcm per year.

- **Alexandroupoli Independent Natural Gas System**: New offshore LNG with 28 km length of subsea and onshore pipeline (4 km onshore and 24 km offshore), with storage capacity of 170k m³ and pumping capacity of 6.1bcm per year.

- **Kavala LNG**: Floating storage (170k m³ LNG capacity) and processing terminal (annual sent-out capacity of 3-5bcm) at Kavala Bay.
Rail projects amount to €7.4bn, with 66% on urban rail projects

- 35% of the rail projects account to urban rail interconnections (Attiko Metro, Tram, Metro Thessaloniki), while the remaining 65% to rail projects.
- More than half of the rail projects have already started with further Attiko Metro and Thessaloniki Metro extensions and some Ergose upgrades in planning.
- 2 rail projects are expected to be delivered in 2019, the Tithorea-Domoko rail line and the Athens Tram extension to Piraeus.
- The percentage of electrified lines in Greece is only 24% compared to the European average of 54% (International Union of Railways, 2017). However, Greece is making progress in rail electrification by converting and adding about 740km of electrified lines to the national network.
Urban rail account for the bulk of the investment expenditure in rail

- 34% of the remaining budget accounts to rail projects, while the remaining 66% to urban rail
- Attiko Metro’s new lines and extensions are the largest urban rail projects, with a total budget of €3.3bn taking up about 68% of the remaining budget of the urban rail projects
- The average investment in railway projects is estimated at €5.9mn/km, while the respective investment in urban railways stands at €112.4mn/km
Rail projects geographical distribution

- Construction of **Metro in Thessaloniki** and extension to Kalamaria (14.3km) serving 315k passengers per day
- The new **Metro Line 4** in Athens with 33km length (31 new stations) is expected to serve around **500k passengers** daily, especially at densely populated areas (Kipseli, Pagrati, Zografou)
- Extension of **Athens metro to Piraeus** (6 new stations) connecting the Athens International Airport with the Port of Piraeus will increase current capacity to **123k passengers**
- **Tram extension from N. Faliro to Piraeus** (5.3km) will have a daily capacity of 100k passengers
- Construction of double rail tracks and upgrading of signaling and electrification of the main OSE network to **improve customer service and time of travel** rendering rail an efficient alternative for **long distance travel**
- The construction and electrification of the **Kiato to Patras** will connect Athens to Patras and Northern Peloponnese again after a long time
Motorways investment pipeline is about € 4.3bn

Estimated Completion year (cumulative)

<table>
<thead>
<tr>
<th>Year</th>
<th>Planned</th>
<th>In progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2020</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2021</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2022</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>2023</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>2024</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

Number of projects with no announced commencement/completion dates

- After the completion of many large motorway projects in 2017, the only major road projects in the pipeline are the Crete Northern highway, the southern and northern parts of E65 and the Patras-Pyrgos link.

- One of the largest projects that was announced in 2018 was the Crete Northern highway, with a total length of 300km and the projected delivery date is 2024.

- The total motorway kilometers of planned and in progress projects in Greece amount to 867km, of which only 14% has already been constructed.

- The average cost of motorway construction in Greece is €14.6mn per km.
Motorway projects geographical distribution

- **Egnatia Odos vertical Axes** will connect the main part of Egnatia Odos with **Bulgaria** and **Serres with Drama and Kavala**
- **Ionia Odos side Axis**, with a length of 48.5km will connect **Aktio to Amvrakia**
- The relative cost of construction of major motorways per km is estimated at **€6.4mn/km**, while the respective European average stands at **€11.6mn/km** (Infrastructure Journal, 2010)
- The Northern and Southern parts of the **Central Greece Motorway** (part of E65 Motorway) are under construction with a total length of 175km and will connect Lamia, Karditsa and Trikala with Egnatia Odos.
- The **Patras-Pyrgos Motorway** is a physical extension of Olympia Odos with a total length of 75 km and will establish a better connection between the two cities
- **Crete Northern highway** is one of the largest projects that was announced in 2018, with a total length of 300km

**Average delays in road investment projects**
Number of months from planned completion

<table>
<thead>
<tr>
<th>Country</th>
<th>Greece</th>
<th>Spain</th>
<th>Germany</th>
<th>Poland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delays</td>
<td>16</td>
<td>11</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

source: ECA, Are EU Cohesion Policy funds well spent on roads? (2013), PwC analysis
For the upgrading of the tourist product around €1.3bn have been scheduled

61% of the tourist infrastructure projects are not even fully planned except from the new dock at the Port of Thessaloniki and Kasteli airport which are scheduled to be completed by 2022 and 2025 respectively.

There is no information on the construction of the key marinas (Katakolo & Zakynthos, Alimos hub, Glyfada hub, Patra hub, Chios hub, Crete hub, Pylos hub and Aretsou Kalamarias hub) except for the marina of Symi which was delivered in 2018.

The average budget for tourist infrastructure amounts to €77.6mn per project.

Source: Press, PwC calculations
Greece is a significant global tourist destination, attracting 30mn arrivals in 2018, and €16bn in tourist receipts.

Despite being a global tourist attraction, the tourist infrastructure quality in Greece is of low quality.

For Greece to remain a top global tourist destination it is necessary to:

- **Complete the upgrade** of the 14 regional airports acquired by the Slentel-Fraport joint venture and upgrade the second wave of airport privatizations as well as the construction of the new airport in Kasteli.
- **Upgrade vital ports** to serve as transit terminals and facilitate interconnection with neighbor countries.
- **Modernise key marina hubs** (Alimos, Kalamaria, Chios, Crete, Glyfada, Zakynthos & Katakolo, Patra, Pyllos and Rhodes & Kos) to meet the increasing demand in marine tourism.
Waste management projects need about €0.9bn

- Within 2018, 2 PPPs were signed for waste management projects in Alexandroupoli and Peloponnese and 1 more is expected to be signed in Aitoloakarnania.
- Also, 5 waste management projects are expected to be completed in 2019 (Grammatiko, Serres, Voitia, Epirus and the water pipeline of Aegina).
- The average budget of waste management projects amounts to €69mn per project.

Source: Press, PwC calculations
In 2015, an updated national waste management plan was adopted which defines the strategy, the policy and the targets of waste management on a national level and also the general obligations and appropriate measures for the treatment of waste. The National Waste Management Plan contains sufficient information on criteria for site identification and on the capacity of future disposal or major recovery installations, on the existing waste collection schemes and major disposal and recovery installations as well as for the waste prevention programmes.

Regional Management Plans have already been published dealing with an analysis of the current waste management situation as well as the measures to be taken, providing for an adequate and integrated network of disposal installations. The landfill sites or major waste treatment sites should be mentioned in the regional waste management plan. However, the specific future sites are not mentioned, so local conflicts arise.

The number of illegal landfills that are still operational or in need of rehabilitation has fallen over the years. However, according to the European Commission’s 2018 ‘Early Warning Report’, Greece is at risk of not meeting the 2020 municipal waste recycling target of 50%.

On urban waste-water treatment there have been some positive steps, such as the systematic assessment and strategic reorganisation of the country’s investment needs. These efforts should lead to the necessary infrastructure being installed quickly.
The current project portfolio is heavy on energy and transport and short on non-electricity connectivity, tourism and the environment.

- The value of 88 infrastructure projects in progress or planned is standing at €25bn.
- Projects in progress account for 33% of estimated investment.
- For 39% of the projects, commencement and completion dates are not known.
- The transport and energy sectors account for almost 91% of the pipeline of all projects and the smooth evolution of those investments will have a very positive impact in economy.
- Investments in tourism product upgrade (5%), as well as in waste management and water supply (4%) are important for tourism growth and the upgrade of life quality.
4

Funding Greek infrastructure
Infrastructure funding and project delays

• Projects should be assessed not only on their initial capital investment but also on the operational cost, maintenance, disposal and value-for-money across the asset lifecycle
• A poorly designed project may lead to delivery delays, higher costs and lower financial returns
• Project risk management has to be a core element of project selection, planning, and design, and it has to be continuous across the entire life cycle of the project
Infrastructure projects suffer from systematic slippage both in preparation and execution

Number and budget of delayed projects

- 28 months slippage* in execution/construction
- 23 months slippage** in preparation

- The average delay of a project from planned commencement is 23 months, while their completion date is pushed back on average by 28 months.
- On average, at the outset, a project is likely to be 51 months late from its initial completion date.

Projects in progress have already started construction but their completion date has been delayed.
Upcoming projects are in the stage of planning or bidding and there is a commencement/completion date.
Projects in early planning have not published yet a commencement/completion date.

*Average delay in months from the initial completion date until the date a project in our database was officially delivered.
**Average delay in months from the initial commencement date until the date a project in our database officially commenced construction.

The database captures projects since 2014.
Possible delays will reduce infrastructure spending by as much as €3.8bn in the period to 2024

Remaining budget (in €bn)

- The delays will reduce for the first 3 years the average annual investment to 1.2% of GDP from an expected 2.2%
- €8.2bn of pipeline are in the planning phase and need to be assigned a commencement date

*Remaining budget with delays was calculated by applying the delays to each project and then recalculating each project’s remaining budget
The current active pipeline, with no delays, is above the historic rate of infrastructure investment by around € 4bn.

- € 12.3bn: Expected historic rate of infrastructure investment for the period 2019 - 2024.

- € 15.8bn: In planned and work in progress pipeline without assumed delays for the period 2019-2024.

If delays are factored in, the investment over 2019-2024 drops to € 11.9bn with a lag of around € 4bn. Delays in the execution of the current pipeline may undercut GDP growth by ca. 0.8pp.
Infrastructure investment slippage and slow preparation undercut economic growth and demand a different approach

Commencement and completion delays to be contained

The current backlog of infrastructure projects includes €8.2bn of projects in advanced planning stages which need to move to execution mode

- Single preparation mechanism
- Full use of concessionary and private funding
Unified project planning will reduce delays and facilitate funding and project control

• There should be a single state organisation mandated with the planning, design and management of all major infrastructure projects (e.g. ≥ €20mn) to reduce delays and maximise private funding, as per Special Secretariat of PPP
• Ministries, local authorities and the private sector will submit project concepts at the pre-feasibility level to the IICU for vetting
• If accepted, the IICU will manage the preparation and the funding process
Make use of all financing options

Public-private partnerships (PPPs)
Private investment in infrastructure, in partnership with the public sector, increases accountability in the delivery, stretches public budget and helps governments deliver projects faster, cheaper and ensure that they are properly maintained.

EC funding
- Projects of common interest (PCI)
- Juncker plan
- Other concessionary facilities

Project Bonds
Project Bonds could provide a significantly higher private sector participation in infrastructure funding adding a low risk element in institutional investors’ portfolios.

Tax increment financing
Tax increment financing earmarks incremental property tax revenues to service debt incurred to develop new transit infrastructure.

Asset recycling
Asset recycling uses proceeds from the sale of existing assets to finance new development (e.g. Kasteli airport).

Value capture
Value capture leverages the value of property made viable by new infrastructure, such as a subway line extension, to finance that new infrastructure.

Better municipal asset management
Municipalities own substantial properties that are often underutilised. With more proactive asset management, cities could extract significant value that can be invested in infrastructure.
Delays are endemic in Greek infrastructure projects and curtail its positive economic impact

- It is essential infrastructure projects are assessed based on value-for-money across their asset lifecycle
- Infrastructure projects in Greece suffer from systematic slippage both in preparation and execution, with an average 23 months of slippage in preparation/design and 28 months of slippage in execution/construction
- Possible delay factors range from government and contractor issues to general and environmental problems
- Estimated delays in the execution of the current pipeline may undercut GDP growth by ca. 0.8pp per annum
- Accelerating the preparation of projects and minimizing slippage requires better coordination across the whole process and full use of concessionary and private funding
- There should be a single state organisation mandated with the planning, design and funding of all major infrastructure projects in order to reduce delays and secure private funding
- PPPs and Project Bonds could provide a significantly higher private sector participation in infrastructure funding, supported by EC funding
Conclusions
Conclusions

- Global infrastructure investment is expected to reach $3.5trln per annum in the period to 2040 or 3.2% of global GDP
- The quality and extent of infrastructure is below our European peers
- In Greece, there is a systematic infrastructure investment gap of 0.7pps of GDP, resulting in a €13bn permanent shortage over the past 10 years, created by the deep recession and consequent budgetary constraints
- Infrastructure investments are vital for the Greek economy, having a high economic multiplier (ca. 1.8x) which can boost consumption and investment in other sectors
- The number of planned and in progress infrastructure projects are not decreasing during the crisis. In 2018, their total cost is estimated at €25bn
- €10.6bn of the remaining budget refers to Energy projects, while €7.4bn to Railways and €4.3bn to Motorways. Tourist infrastructure and Waste management projects account for a small part of the remaining budget taking up only about €1.3bn and €0.9bn respectively
- The current project portfolio is heavy on energy and transport and short on connectivity, tourism and the environment
- Infrastructure projects in Greece suffer from systematic slippage both in preparation and execution, with an average 23 months of slippage in preparation/design and 28 months of slippage in execution/construction. Possible delays in execution will lead to a loss of investment of around €4bn by 2024 with a 0.8pp p.a. negative impact on GDP, which makes imperative to move the backlog of €8.2bn of investment in the planning stage forward
- The main factors contributing to the systematic shortfall of infrastructure investment are poor planning, slow process of political consensus and delays. Delays are endemic in Greek infrastructure and curtail its positive economic impact
- Accelerating the preparation of projects and minimizing slippage requires better coordination across the whole process and full use of concessionary and private funding
- There should be a single state organisation mandated with the planning, design and management of all major infrastructure projects to reduce delays and maximise private funding
Appendix I – Infrastructure projects* in Greece

<table>
<thead>
<tr>
<th>Number</th>
<th>Infrastructure Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Energy projects</td>
</tr>
<tr>
<td>14</td>
<td>Rail projects</td>
</tr>
<tr>
<td>8</td>
<td>Motorway projects</td>
</tr>
<tr>
<td>15</td>
<td>Tourist infrastructure projects</td>
</tr>
<tr>
<td>16</td>
<td>Waste management projects</td>
</tr>
</tbody>
</table>

* Some projects have been grouped together and thus projects depicted at the tables do not add up to 88 projects.
Energy accounts for ca. € 10.6bn of investments

### Interconnection Projects

<table>
<thead>
<tr>
<th>No</th>
<th>Interconnection Projects</th>
<th>Capacity (MW)</th>
<th>Remaining Budget (€ mn)</th>
<th>Start Date</th>
<th>Completion Date*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>TAP (Trans - Adriatic Pipeline)</strong></td>
<td>N/A</td>
<td>1,068</td>
<td>2016</td>
<td>2023</td>
</tr>
<tr>
<td>2</td>
<td><strong>Electricity Interconnectors</strong> (Euroasia Interconnector, Ariadne Interconnection, Cyclades, Maritsa East (BG) - Nea Santa (GR))</td>
<td>5,070</td>
<td>4,260</td>
<td>2019</td>
<td>2014</td>
</tr>
<tr>
<td>3</td>
<td><strong>LNGs</strong> (Alexandroupolis LNG, Kavala LNG)</td>
<td>N/A</td>
<td>655</td>
<td>N/A</td>
<td>2017</td>
</tr>
<tr>
<td>4</td>
<td>Kavala storage facility (Undeground Storage facility)</td>
<td>N/A</td>
<td>240</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td><strong>IGB (GR-BG Natural Gas pipeline)</strong></td>
<td>N/A</td>
<td>145</td>
<td>2019</td>
<td>2020</td>
</tr>
<tr>
<td>6</td>
<td><strong>Development of natural gas distribution network</strong> in the regions of Eastern Macedonia-Thrace, Central Macedonia and Sterea Ellada</td>
<td>N/A</td>
<td>172</td>
<td>2019</td>
<td>2023</td>
</tr>
<tr>
<td>7</td>
<td><strong>Gas Compressor Station</strong> (Kipoi)</td>
<td>N/A</td>
<td>25</td>
<td>2017</td>
<td>2019</td>
</tr>
</tbody>
</table>

**Total Budget**  
6,565

### Power Generation

<table>
<thead>
<tr>
<th>No</th>
<th>Power Generation</th>
<th>Capacity (MW)</th>
<th>Remaining Budget (€ mn)</th>
<th>Start Date</th>
<th>Completion Date*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Ptolemaida 5 Power Plant (lignite fired)</strong></td>
<td>660</td>
<td>1,028</td>
<td>2015</td>
<td>2021</td>
</tr>
<tr>
<td>2</td>
<td><strong>Mytilineos power plant in Voiotia</strong></td>
<td>665</td>
<td>300</td>
<td>2019</td>
<td>2022</td>
</tr>
<tr>
<td>3</td>
<td><strong>Wind Parks</strong></td>
<td>1,479</td>
<td>1,723</td>
<td>2018</td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td><strong>Amfilochia Hydro-pumped storage</strong></td>
<td>680</td>
<td>502</td>
<td>2019</td>
<td>2023</td>
</tr>
<tr>
<td>5</td>
<td><strong>Hybrid Stations in Siteia and Rethymno</strong></td>
<td>139</td>
<td>280</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td><strong>Solar Parks (Kozani, Anthofyto)</strong></td>
<td>212</td>
<td>190</td>
<td>N/A</td>
<td>2018</td>
</tr>
</tbody>
</table>

**Total Budget**  
4,023

*Commissioning date  
Source: Press, PwC calculations
Rail projects amount to €7.4bn, with 66% coming from urban rail projects

<table>
<thead>
<tr>
<th>No</th>
<th>Upcoming Projects</th>
<th>Details</th>
<th>Remaining Budget (€mn)</th>
<th>Start Date</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attiko Metro</td>
<td>Extension of Line 3 to Piraeus, New Line 4, Line 4 Extension to Perissos and Lykovrisi</td>
<td>3,300</td>
<td>2012-2019</td>
<td>2021</td>
</tr>
<tr>
<td>2</td>
<td>Thessaloniki Metro</td>
<td>Main line &amp; Extensions to Kalamaria and Western suburbs</td>
<td>1,528</td>
<td>2006-2018</td>
<td>2020-2026</td>
</tr>
<tr>
<td>3</td>
<td>Athens Tram</td>
<td>Extension to Piraeus</td>
<td>32</td>
<td>2013</td>
<td>2019</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td></td>
<td><strong>4,860</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>Upcoming Projects</th>
<th>Details</th>
<th>Remaining Budget (€mn)</th>
<th>Start Date</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ergose Tithorea</td>
<td>Tithorea- Domoko</td>
<td>216</td>
<td>2013</td>
<td>2019</td>
</tr>
<tr>
<td>2</td>
<td>Ergose Palaiofarsalos</td>
<td>Palaiofarsalos - Kalambaka (electrification of railways)</td>
<td>54</td>
<td>2019</td>
<td>2022</td>
</tr>
<tr>
<td>3</td>
<td>Ergose Volos</td>
<td>Volos – Larissa (electrification of railways)</td>
<td>92</td>
<td>2019</td>
<td>2023</td>
</tr>
<tr>
<td>4</td>
<td>Ergose Polikastro</td>
<td>Polikastro - Idomeni</td>
<td>48</td>
<td>2007</td>
<td>2021</td>
</tr>
<tr>
<td>5</td>
<td>Ergose Port of Kavala</td>
<td>Connection of the Port of Kavala to the existing Thessaloniki-Alexandroupoli line</td>
<td>250</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>Ergose Central Macedonia</td>
<td>Upgrade of the network in Central Macedonia</td>
<td>35</td>
<td>2019</td>
<td>2021</td>
</tr>
<tr>
<td>7</td>
<td>Ergose Athens</td>
<td>Upgrade of Athens Train Station</td>
<td>41</td>
<td>2019</td>
<td>2022</td>
</tr>
<tr>
<td>8</td>
<td>Ergose Promachononas</td>
<td>Upgrade of existing line Thessaloniki-Promachononas</td>
<td>120</td>
<td>2021</td>
<td>2023</td>
</tr>
<tr>
<td>9</td>
<td>Ergose Rhododafni</td>
<td>Kiato-Rhododafni, Rhododafni-Psathopyrgos, Psathopyrgos-Patras and electrification of railways</td>
<td>642</td>
<td>2006</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>Ergose Xanthi</td>
<td>Thessaloniki-Kavala-Xanthi new line</td>
<td>1,000</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>11</td>
<td>Ergose Sepolia</td>
<td>Ergose: Upgrade of the network in Sepolia</td>
<td>57</td>
<td>2018</td>
<td>2023</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td></td>
<td><strong>2,556</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Press, PwC calculations
Motorways investment pipeline is about € 4.3bn

<table>
<thead>
<tr>
<th>No</th>
<th>Upcoming Projects</th>
<th>Details</th>
<th>Total Km</th>
<th>Total Budget (€ mn)</th>
<th>Remaining Budget (€ mn)</th>
<th>Start Date</th>
<th>Estimated Completion Date</th>
<th>Average investment/ km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crete Northern Highway</td>
<td>Chania - Chersonissos, Chersonissos - Neapoli &amp; Neapoli - Agios Nikolaos</td>
<td>300</td>
<td>1,315</td>
<td>1,315</td>
<td>2019</td>
<td>2024</td>
<td>4.4</td>
</tr>
<tr>
<td>2</td>
<td>E65 Motorway (Lamia-Egnatia)</td>
<td>Lamia - Xyniada &amp; Trikala - Egnatia</td>
<td>96</td>
<td>1,126</td>
<td>594</td>
<td>2008</td>
<td>2022</td>
<td>11.7</td>
</tr>
<tr>
<td>3</td>
<td>Egnatia Odos</td>
<td>Vertical axes: Ardanio-Ormenio &amp; Mandra-Psathades, Serres-Drama-Kavala, Xanthi-Echinos</td>
<td>173</td>
<td>920</td>
<td>910</td>
<td>2011</td>
<td>N/A</td>
<td>5.3</td>
</tr>
<tr>
<td>4</td>
<td>Ionia Odos</td>
<td>Aktion-Amvrakia Vertical Axis</td>
<td>49</td>
<td>150</td>
<td>93</td>
<td>2010</td>
<td>2021</td>
<td>3.1</td>
</tr>
<tr>
<td>5</td>
<td>Regional roads</td>
<td>Ring road of Katerini, Thessaloniki-Doirani, Circumvention of Chalkida, Circumvention of Lagkadia, Kalamata-Rizomylos-Pylos-Methoni &amp; Kalo Nero - Tsakona</td>
<td>167</td>
<td>774</td>
<td>711</td>
<td>2013</td>
<td>2011</td>
<td>2019</td>
</tr>
<tr>
<td>6</td>
<td>Underwater tunnel Salaminas</td>
<td>Underwater connection of Salamina and Perama</td>
<td>5</td>
<td>350</td>
<td>350</td>
<td>2019</td>
<td>N/A</td>
<td>71.4</td>
</tr>
<tr>
<td>7</td>
<td>Underwater tunnel Lefkada</td>
<td>Underwater connection of Lefkada and Etoloakarnania</td>
<td>3</td>
<td>50</td>
<td>50</td>
<td>N/A</td>
<td>N/A</td>
<td>16.7</td>
</tr>
<tr>
<td>8</td>
<td>Patras-Pyrgos Motorway</td>
<td>Patras-Pyrgos</td>
<td>75</td>
<td>293</td>
<td>244</td>
<td>2019</td>
<td>2022</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>867</td>
<td>4,978</td>
<td>4,266</td>
<td></td>
<td></td>
<td>5.7</td>
</tr>
</tbody>
</table>

Source: Press, PwC calculations
For the upgrading of the tourist product around € 1.3bn have been scheduled

<table>
<thead>
<tr>
<th>No</th>
<th>Projects</th>
<th>Remaining Budget (€mn)</th>
<th>Start Date</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kasteli Airport in Heraklion</td>
<td>480</td>
<td>2020</td>
<td>2025</td>
</tr>
<tr>
<td>2</td>
<td>Regional Airports</td>
<td>332</td>
<td>2017</td>
<td>2021</td>
</tr>
<tr>
<td>3</td>
<td>OLTH, new dock</td>
<td>150</td>
<td>2018</td>
<td>2022</td>
</tr>
<tr>
<td>4</td>
<td>Igoumenitsa Port upgrade</td>
<td>42</td>
<td>2008</td>
<td>2019</td>
</tr>
<tr>
<td>5</td>
<td>Macedonia Airport upgrade</td>
<td>96</td>
<td>2005</td>
<td>2020</td>
</tr>
<tr>
<td>6</td>
<td>Ioannina Airport upgrade and new terminal</td>
<td>9</td>
<td>2010</td>
<td>2019</td>
</tr>
<tr>
<td>7</td>
<td>Port of Patras upgrade</td>
<td>37</td>
<td>2012</td>
<td>2019</td>
</tr>
<tr>
<td>8</td>
<td>Key marinas</td>
<td>42</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>9</td>
<td>Luxury marines (Mykonos, Argostoli)</td>
<td>9</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>Upgrading/ Maintenance of Regional Ports</td>
<td>13</td>
<td>2019</td>
<td>N/A</td>
</tr>
<tr>
<td>11</td>
<td>Layrio Mega Yacht</td>
<td>4</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>12</td>
<td>Metropolitan Water Airport (Port of Thessaloniki)</td>
<td>0.4</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>13</td>
<td>Athens International Airport Small expansion</td>
<td>12</td>
<td>2018</td>
<td>2019</td>
</tr>
<tr>
<td>14</td>
<td>Construction of a new marina in Nafplio</td>
<td>9</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>15</td>
<td>Upgrading of Marina of Alimos</td>
<td>50</td>
<td>2019</td>
<td>2024</td>
</tr>
<tr>
<td></td>
<td>Total Budget</td>
<td>1,284</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Press, PwC calculations
Waste management projects need about € 0.9bn

<table>
<thead>
<tr>
<th>No</th>
<th>Projects</th>
<th>Remaining Budget (€mn)</th>
<th>Start Date</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Center of Sewage Treatment (Koropi - Paania)</td>
<td>77</td>
<td>2013</td>
<td>2020</td>
</tr>
<tr>
<td>2</td>
<td>Waste management (Aetoloakarnania)</td>
<td>15</td>
<td>2019</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>Waste management in Attica (Northeastern Attica - Grammatiko)</td>
<td>5</td>
<td>2006</td>
<td>2019</td>
</tr>
<tr>
<td>4</td>
<td>Waste management (Ilia)</td>
<td>38</td>
<td>2019</td>
<td>2021</td>
</tr>
<tr>
<td>5</td>
<td>Waste management (Serres)</td>
<td>24</td>
<td>2017</td>
<td>2019</td>
</tr>
<tr>
<td>6</td>
<td>Waste Management (Peloponissos)</td>
<td>126</td>
<td>2018</td>
<td>2020</td>
</tr>
<tr>
<td>7</td>
<td>Waste management (Alexandroupoli)</td>
<td>58</td>
<td>2019</td>
<td>2020</td>
</tr>
<tr>
<td>8</td>
<td>Water Pipeline Aegina</td>
<td>20</td>
<td>2016</td>
<td>2019</td>
</tr>
<tr>
<td>9</td>
<td>Waste management (Voiotia)</td>
<td>11</td>
<td>2017</td>
<td>2019</td>
</tr>
<tr>
<td>10</td>
<td>Connection of Pallini and Gerakas Sewage Systems to Psyttaleia</td>
<td>72</td>
<td>2019</td>
<td>2023</td>
</tr>
<tr>
<td>11</td>
<td>Center of Sewage Treatment (Marathonas)</td>
<td>130</td>
<td>N/A</td>
<td>2023</td>
</tr>
<tr>
<td>12</td>
<td>Center of Sewage Treatment (Rafina-Artemida)</td>
<td>220</td>
<td>2019</td>
<td>2023</td>
</tr>
<tr>
<td>13</td>
<td>Waste management (Achaia)</td>
<td>50</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>14</td>
<td>Waste management (Epirus)</td>
<td>35</td>
<td>2017</td>
<td>2019</td>
</tr>
<tr>
<td>15</td>
<td>Waste management (Kerkyra)</td>
<td>33</td>
<td>2019</td>
<td>2021</td>
</tr>
<tr>
<td>16</td>
<td>Waste management (Rhodes)</td>
<td>38</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td><strong>952</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Press, PwC calculations
Appendix II – Challenges and sources of funding
Each infrastructure side faces different challenges that may impact the delivery and the budget of each project

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Government</th>
<th>Contractor/concessionaire</th>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow process of political consensus</td>
<td></td>
<td>Risk distribution between the state and the contractor</td>
<td>Projects poorly planned</td>
</tr>
<tr>
<td>Delays in work clearance/approval</td>
<td></td>
<td>Disputes between the state and the contractor</td>
<td>Risk distribution</td>
</tr>
<tr>
<td>Unexpected requirements</td>
<td></td>
<td>Failure to coordinate sub-contractors</td>
<td>Site development difficulties</td>
</tr>
<tr>
<td>Unexpected design variations</td>
<td></td>
<td>Late payment of workers during construction</td>
<td></td>
</tr>
<tr>
<td>Funding problems</td>
<td></td>
<td>Poor performance/poor project management</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design changes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inflation/Relative price changes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land acquisition costs/Expropriation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demand variations</td>
<td></td>
</tr>
</tbody>
</table>
Public & Private Partnerships

5 Signed* PPPs
*Projects in operation or under construction

Design, financing, construction, maintenance and operation of the facilities for the integrated waste management system in:
- Western Macedonia, € 49mn
- Serres, € 36.1mn
- Epirus, € 52.4mn
- Peloponnese, € 150mn
- Ilia, € 38mn

5 waste management projects

9 Approved PPPs

- Corfu, € 40mn
- Achaia, € 50mn
- Etoloakarnania, € 45mn
- Rhodes, € 38mn
- Alexandroupoli, € 58mn

- Chersonisson-Neapoli part of Crete Northern highway, € 290mn
- Kalamata-Rizomylos-Pylos-Methoni road axis, € 180mn
- Marina of Nafplio, € 9mn

1 tourist upgrading project

Total budget for these projects is € 325mn, of which 36% is state funded

Total budget for these projects is € 710mn

Up to now, PPP projects of € 822mn have been signed since 2009, mostly schools, networks and waste management projects as well. The pipeline of approved PPPs reaches € 1.7bn

Source: sdit.mnec.gr
At PwC, our purpose is to build trust in society and solve important problems. We’re a network of firms in 158 countries with more than 250,000 people who are committed to delivering quality in assurance, advisory and tax services. Find out more and tell us what matters to you by visiting us at www.pwc.com.

This publication has been prepared for general guidance on matters of interest only, and does not constitute professional advice. You should not act upon the information contained in this publication without obtaining specific professional advice. No representation or warranty (express or implied) is given as to the accuracy or completeness of the information contained in this publication, and, to the extent permitted by law, PwC does not accept or assume any liability, responsibility or duty of care for any consequences of you or anyone else acting, or refraining to act, in reliance on the information contained in this publication or for any decision based on it.

©2019. PricewaterhouseCoopers Business Solutions SA. All rights reserved. PwC refers to the Greece member firm, and may sometimes refer to the PwC network. Each member firm is a separate legal entity. Please see www.pwc.com/structure for further details.