Securing macro-economic gains from decarbonisation investment: the finance dimension and an Italian case study

↘ The transition to a low carbon economy is a capital-intensive process requiring large-scale finance of suitable low-carbon investment programmes
The challenge of long-term investing is linked to the expansion of efficient (e.g. low cost) private finance for capital-intensive low-carbon assets, on both the supply (financial structures) and demand side (energy technologies and policies) of investment decisions.

↘ Different policies in place and country risk profiles determine wide variation of investments' rate of returns across markets and sectors
In 2016, the range of financing costs in the 'green and renewables' sector varies from 3.4 % in Germany to 8 % or more in Greece and many emerging markets, reflecting perceived risks associated with these countries and their relevant energy-climate policies.

↘ Public policies are key to decarbonise investment
Disclosure initiatives and reliable long-term strategies, commitments and commensurate policies are crucial to improve the attractiveness of low-carbon investments, reduce the cost of capital, and speed up the low-carbon transition.

↘ Modelling a case study of a green growth strategy in Italy shows how decarbonisation in energy and transport can boost the economy to 2030
An Italian case models the conditions in which efficient finance, specifically of low carbon investments in the energy and transport sectors, along with the resulting innovation and manufacturing benefits, delivers deep decarbonisation (> 60 % by 2050) together with improved economic performance over coming decades.

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GREEN WIN

The transition to a low carbon economy is a capital-intensive process requiring large-scale finance of suitable low-carbon investment programmes

What is the investment challenge?

The low-carbon transition requires $40 trillion investment between 2016 and 2050

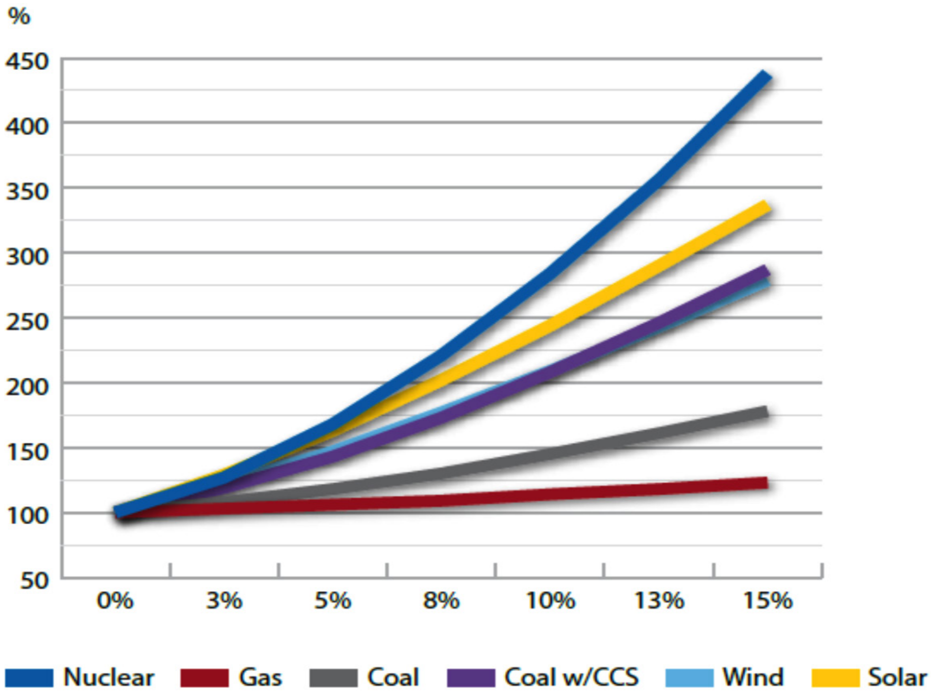
Two years since the negotiation of the Paris Agreement, the global community faces significant challenges in mobilizing the investment required to meet green-house gas (GHG) emissions to a level that would meet the goals established. The International Energy Agency (IEA) estimate that an additional $40 trillion global cumulative investment in low-carbon technologies and energy efficiency between 2016 and 2050 (over $1 trillion a year on average) is required, compared to a situation in which emissions are not reduced[1]. The level of current investment, however reveals a considerable finance gap. In 2016, global flows of mitigation-related 'climate finance' – defined as capital flows directed towards low-carbon interventions with direct greenhouse gas mitigation benefits[2] - reached around $383 billion[3]. Clearly, the scale of such investment needs to expand. In the GREEN-WIN project we have investigated the conditions which might attract such levels of finance, and whether and how this could lead to net economic gains on timescales to make this politically attractive.

There is no shortage of capital available globally – the financial sector encompasses more than EUR 100 trillion of assets globally – but several factors inhibit the expansion of private finance in low-carbon investment, despite potential macro-economic gains from doing so, as summarised in this paper.

What affects the scale of finance and the demand for low-carbon investment?

The transition to a low carbon economy is a capital-intensive process requiring large scale finance at combined with suitable low-carbon investment projects. The relative attractiveness of different energy investments may be substantially affected by their cost of capital, depending upon the relative capital intensity, construction times, perceived risks and expected operating lifetimes of the asset. The higher the cost of capital, the more up-front investment costs will weigh, making the cost of capital (often equated with the discount rate in levelised-cost calculations) itself is one key component of the levelised cost of electricity (LCOE) generation. Figure 1 shows how much this financing cost affects the levelised energy cost of different technologies, compared to a hypothetical zero rate (free money / no cost of capital), illustrating the disproportionate impact that the cost of capital has on the relative cost – and attractiveness – of low carbon options.

Figure 1. Impact of Weighted Average Cost of Capital (WACC) /discount rate on levelised cost of energy



Note: The chart shows the levelised cost relative to 'free capital' (zero finance cost) rate
Source: IEA, Projected costs of electricity generation (Source: IEA, 2010).

Stable and predictable policies drive finance

Factors affecting the scale of finance operate at both general and sector levels, on both the supply (financial structures) and demand side (energy technologies and policies) of investment decisions. They include perceived country risk, the policy framework, investors' experience and performance track record in the sector, and analytical approaches to assess climate risks and opportunities.

Of the factors driving demand, transparency, predictability and longevity of government programmes are determining factors to convince investors to commit funds to low-carbon projects. For instance, retroactive changes in the term of contracts, or rapid and unplanned policy changes in the tariff level, regarding solar power projects have concerned investors, respectively in Spain and Italy. In addition, the relative novelty of low-carbon investments and the lack of data and operational comparisons make it a challenging sector for investors. Even where they can see the benefits of low-carbon investment, they may not be able to precisely assess the risk profiles. Finally, investors' difficulty to apply analytical approaches such as internal carbon pricing and portfolio carbon footprinting (e.g. carbon emissions associated with their portfolios) as part of their strategic planning process to manage potential risks and opportunities, impede capitals allocation towards low-carbon projects.

Appropriate financial instruments, reporting systems and projects' characteristics affect the scale of finance

Supply-side factors include limitations of appropriate investment instruments. Investment strategies, both direct and indirect, entail high transaction costs associated with investment appraisal and due diligence in direct investing, and high management and performance fees in indirect channels. Compared to traditional large-scale capital investment, the market for low-carbon investments remains i) small with the challenge to ensure a pipeline of bankable projects offering returns that are attractive to investors and respond to their risk management needs; ii) illiquid (e.g. the volume of green bonds traded is about 2% of the total bond market) and iii) there is often a mismatch for instance been institutional investors' long-term, relatively low risk needs and the financing vehicles available.

Often, project size tends to be too small to attract institutional investors. The minimum value needed in order to justify the transaction costs (e.g. due diligence) for institutional investors is typically £40 million in the UK, €50 million in the rest of Europe and $100 million in the United States, reflecting differences in size of investors from the respective regions of the world. Finally, the lack of high quality estimations and standard reporting to allow appropriate and sufficient due diligence is a key barrier to low-carbon investment. Examples of such data include expected GHG emission reductions and their valuation, structure of the supply chain, and exposure to other market (e.g. policy alterations) and physical (e.g. weather) risks. Although, growing efforts on climate risk disclosure have been made, data related to CO2 intensity of financial portfolios remain lacking.

Different policies in place and country risk profiles determine wide variation of investments' rate of returns across markets and sectors

Financing costs for green assets varies from 3.4% in Germany to 8% or more in Greece, reflecting perceived risks associated with these countries and their energy-climate policies

The cost of capital is determined by the cost of debt and the cost of equity. From an investor's perspective, financing costs (debt and equity) reflect perceived risks and barriers of investing in a given sector and country, and higher risks need to be compensated by a higher return of investment, leading to increased cost of capital.

As shown in Table 1, In 2016, the cost of debt (after tax) varied between 1.4 percent in Germany, 2.6 percent in Italy and Greece, and 3.9 percent in emerging markets. The cost of equity for renewable projects ranged between 5.7 percent in Germany, 7.8 percent in Italy, 14 percent in Greece and 11 percent in emerging markets.

The range of resulting financing costs - the final Weighted Average Cost of Capital (WACC) in the 'green and renewables' sector - varies from 3.4% (in Germany) to 8% or more in Greece and many emerging markets. Italy is closely comparable to the US. By comparing with the costs of electricity presented in Figure 1, it can be inferred that this range of financing cost on its own could increase the cost of solar, compared to gas or coal power, by 50%.

Table 1: Key components of financing costs for different countries

	Selected countries within EU					Outside Europe			
	Germany	France	UK	Italy	Greece*	US	Japan	China	Emerging markets global
Cost of long-term corporate debt:									
Before tax **[1]**	2.0	2.1	2.2	3.7	3.6	4.3	0.3	3.9	5.4
After tax **[2]**	1.4	1.4	1.8	2.6	2.6	2.6	0.2	2.9	3.9
Avg country market risk premium [3]	4.5	5.4	4.5	6.4	11.7	4.5	5.7	5.5	6.3
Cost of equity - green & renewable sectors [4]	5.7	6.7	7.3	7.8	14.1	7.9	n/a	8.7	10.8
Overall WACC - green & renewable sectors [5]	3.4	3.9	4.4	5.1	8.0	5.1	n/a	6.6	8.2

Source: Green-Win D2.4 (2017), "Stylised models of relative rates of return, multiplier, leverage and co-benefit/ spillover effects for key sectors"

[1] Table 2; **[2]** Table 4; **[3]** Table 13; **[4]** Table 14; **[5]** Table 15; * "Eu-Risky countries" index used for some entries; Damodaran (2016b) for some non-EU

** Damodaran (2016b) data for non-EU countries
* "Eu-Risky countries" index used for some entries

Overall, both equity and debt are more expensive in emerging economies and perceived risky countries such as Greece, resulting in higher cost of capitals compared to those in perceived safe countries. Debt markets in emerging economies have been historically characterised by higher yields to compensate the higher risk taken by investors, such as high volatility in the market return, low market liquidity, high inflation and currency risks. The cost of equity is linked to country risk premiums, which have tended to be higher emerging economies though this is becoming more varied. the cost of financing in renewables in emerging markets and perceived risky countries is almost as twice as expensive as in Germany, France or UK.

Public policies are key to decarbonise investment

To effectively encourage investment for the low-carbon economy (such as renewable electricity) and increase their attractiveness, governments must provide a clear, predictable and credible policy framework. This requirement may be deconstructed into three distinct elements.

The first element is the presence and design of policy instruments to alter the balance of value and risk between low-carbon investments and their high-carbon equivalents, to favour the former. The principal prescription of the economist to achieve this is through carbon pricing. Institutional investors are heavily in favour of carbon pricing, with some describing it as 'essential' and 'the only way to lead the low-carbon transition'. Although the application and strength of carbon pricing is increasing around the world, political difficulties prevent their widespread introduction at what may be considered 'sufficient' levels (around 15% of GHG emissions are currently priced, but at significantly varied values[4]). Direct support instruments including subsidies, such as renewable electricity support mechanisms of varied design, and de-risking measures, such as fixed-long term contracts, are widespread. Such instruments must be 'long, loud and legal' if they are to successfully attract investment; they must be clear in how they operate, have transparent rules and processes, and be sustainable in the long-term in order to generate stable returns (for example, have pre-defined mechanisms that respond to developments, such as the declining cost of renewables, to prevent excessive support costs and risk abrupt or retrospective changes – see Box 1).

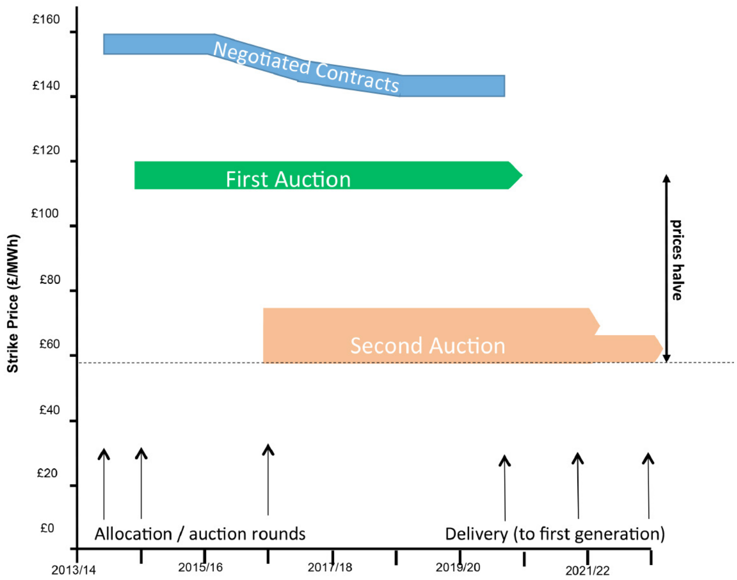
Box 1 – Renewable Electricity Support Mechanisms & Innovation

Historically, renewable electricity technologies such as wind or solar PV, exhibited higher (levelised) costs than conventional, typically fossil fuel generators. Dedicated support (subsidy) mechanisms were therefore used to encourage their deployment. Alongside public R&D funding, such mechanisms (and the deployment they facilitated) led to innovations that reduced the cost of renewable technologies dramatically in recent years.[5] Solar PV is a particularly striking example, with global average costs reducing by 58% between 2010 and 2015 alone[6], and continuing to decline rapidly, becoming the lowest-cost power generation option in many sunny regions around the world.

Innovation in the design of the mechanisms themselves may also reduce the cost of such support. Feed-in tariffs have been the most dominant form support mechanism, however they have often been overly-generous, being slow to adjust to declining costs and hence costly to consumers. As a result, many countries (particularly in the EU) are now shifting towards to more 'market-responsive' designs, such as feed-in premiums (on top of the wholesale price) and competitive bidding processes. In several regions, generators bid in auctions for fixed-price contracts (eg. the 'strike price' in UK auctions of contracts-for-difference, CfDs), which are awarded at the lowest price able to clear the market with sufficient capacity, according to the target volume or level of subsidy on offer. In the CfD system, when the market price for electricity is lower than the strike price, the generator receives a payment equivalent to the difference, and vice versa.

Figure 2 illustrates the evolution of the lowest value strike prices awarded for offshore wind in the UK since 2013 (for different delivery dates). This approach demonstrates how rapid cost reductions in the technology may be captured by the support mechanism, minimising the cost of support passed on to the taxpayer (often on electricity bills).

Figure 2 - UK Contracts-for-Difference Offshore Wind Strike Prices



Source: Adapted from KPMG[7]

Disclosure initiatives and reliable, strategic long-term policies are crucial to improve the attractiveness of low-carbon investments, reduce the cost of capital, and speed up the low-carbon transition

The second element is whether the government or authority in question holds credible long-term goals, targets and strategies for the low-carbon transition, within which specific instruments may operate. Examples include CO2 mitigation targets and decarbonisation 'roadmaps', or related enabling action, such as appropriate land planning or electricity market reform. The presence (or absence) of such long-term thinking and commitments may make investment more (or less) attractive, particularly for institutional investors, which seek to invest in jurisdictions and assets with prospects for long-term, stable returns, and for which it is worth building suitable internal expertise and experience in order to reduce transaction costs. A related issue is the influence of other public policy mechanisms introduced for seemingly unrelated objectives, but which may have indirect effects on investment in the low carbon transition (such as financial sector regulation). Such issues are discussed in another policy brief in this series ("Securing finance for 2° C pathways: the core components").

The third element is the broader context of the prevailing political climate and the rule of law. The political climate indicates whether or not abrupt changes are likely to be made to existing instruments or arrangements (if possible), and the credibility of long-term goals, targets and strategies. Confidence in the rule of law and associated processes and structures that ensure agreements and contracts are upheld is of fundamental importance. Investors examine, for example, the presence and quality of an industry regulator, and mechanisms that prevent the investor from arbitrary action, in order to assess investment suitability.

Alongside establishing a clear, stable and credible policy framework, governments may use their unique role in society to help develop opportunities for investment in the low-carbon economy in other ways.

One concerns a commonly reported barrier to low-carbon investment - a lack of high quality, consistent data. This includes important information on (existing or potential) low-carbon assets, and include information on avoided GHG emissions, technology performance, supply chain and policy risks, and high-carbon assets (e.g. CO2 intensity of activities). This makes reliable assessment of relative opportunities and risks difficult. Governments may require collation and disclosure of such information, and mandate the use of standardised methodologies, to allow for comparative assessment. Examples include the UK's mandatory GHG reporting for companies listed on the London Stock Exchange, and the French climate-related disclosure law for institutional investors, which requires transparency on climate related risk assessments as well as the expected contribution to international climate goals.

Another role can be government as an investor, particularly through public finance institutions (PFIs). PFIs are typically able shoulder greater risk than private sector investors, and may co-invest in order to reduce risk exposure (for example, through the use of 'first loss' guarantees, in which PFIs absorb the value of the potential losses resulting from an investment, to a given threshold). PFIs may also conduct the appropriate due diligence for such investments, reducing transaction costs that may otherwise be prohibitive for (particularly smaller) private investors. PFIs may also 'pool' investment opportunities, allowing private investors to invest at scale, with a diversity of underlying assets. By facilitating private sector investment in low-carbon assets through such actions, these investors are able to build capacity and expertise surrounding the risks and opportunities surrounding low-carbon investment (from technology dynamics to policy frameworks).

A case study of a green growth strategy in Italy

The GREEN-WIN project explores whether and under what conditions near or mid-term economic benefits could be secured from climate change action. Traditional areas of enquiry have explored potential gains from behavioural and organisational ("First Domain") improvements, like enhanced energy and resource efficiency.

In our studies, at national level, we have instead explored two additional potential mechanisms, relating to innovation, and finance. A key part of this has been the further development of the representation of finance and innovation into General Equilibrium modelling, specifically, in the GEM-E3-WIN model that is used for macroeconomic assessments by many institutions including the European Commission and the World Bank. Whilst it is not possible to model directly the impact of policies such as those discussed above, we can explore the macroeconomic implications if effective government policy reduces the financially perceived risks, and helps to accelerate innovation and the capacity to adopt better technologies, through such policies.

For a first case study, the team used the extended version of GEM-E3-WIN to assess the macroeconomic implications from decarbonising the energy system of Italy, one of the 'big four' European economies, accounting for over 10% of EU's GDP. Italy is a particularly interesting case as it is a country also characterised by:

- **Finance.** Italy also has a high level of both private and public debt, at 116% and 133% of GDP respectively; in terms of the finance-indicators of costs of debt, equity and overall WACC, Italy is more costly than Germany, France or the UK, but well below the extremes of Greece – where the conditions are dominated by macro country risks - and average finance indicators are similar to those in the US and China (Table 1).
- **Energy and emissions.** Italy has a mixed energy system, with about half its electricity coming from fossil fuels (more gas than coal) and accounts for 10% of EU greenhouse gas emissions
- **Industry structure.** Italy is a significant equipment manufacture, with a more balanced industrial economy than for example the UK, although it has amongst the highest industrial electricity prices in Europe

Efficient finance for low carbon investments delivers deep decarbonisation (>60% by 2050) together with improved economic performance

A set of alternative macroeconomic scenarios was assessed with GEM-E3-WIN in order to identify: **1.** The drivers and conditions that can lead to Green-growth?, **2.** The net economic effects from decarbonizing the economy?, and **3.** How mitigation policies impact economic growth?

The macroeconomic scenarios reflect different mix of private and public initiatives, different degrees of market imperfections, different regional groups of GHG mitigation action and different ambition regarding the reduction of GHG emissions. The scenarios quantified with the model assume a GHG mitigation action that is compliant with the 2 deg. C target: **1.** EU ETS target for 2030 (40% from 1990 levels), **2.** Non –EU countries adopt their INDCs until 2030, **3.** A carbon club[1] GHG target[2] for 2050 (60 % from 2010 levels).

[1] Two carbon clubs have been considered: A green club that share same climate, energy goals and have access to a common trade area, R&D generated knowledge and financial resources and a brown club where countries are not engaged in any GHG mitigation effort

[2] The target is achieved through a mix of carbon tax, RES and energy efficiency measures. The assumed reduction of the cost of capital facilitates the transition to the decarbonised Italia energy system but it is not the main driver to achieve the GHG emission reductions.

Figures 3 and 4 illustrate the implications for the Italian economy if three key conditions are secured in the low carbon transition, represented in the model runs as:

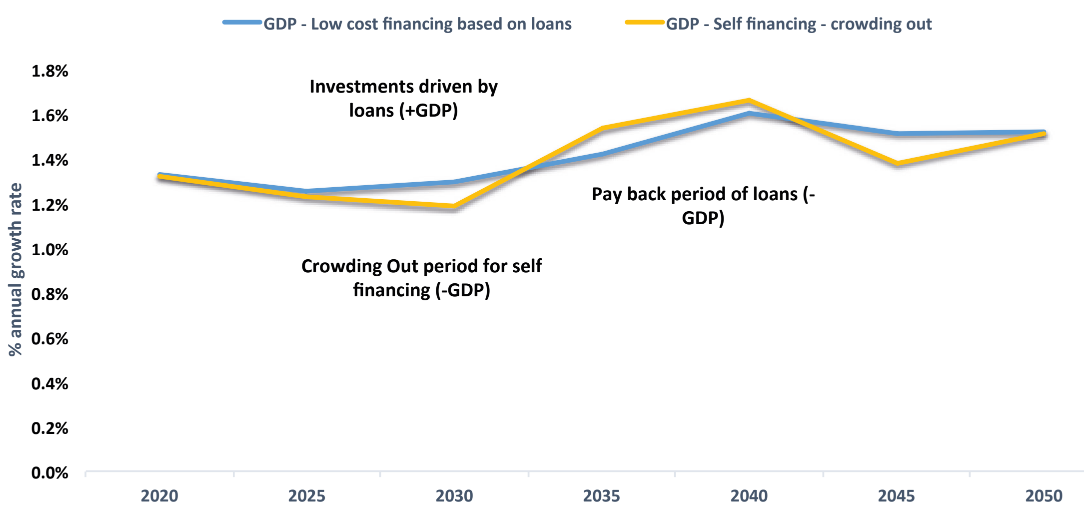
1. **Finance:** Italian firms and households have access to debt at the German rate (Table 1: a 2.6 real interest rate) and can finance 50% of investment from loans at this rate

2. **Technology and manufacturing:** it is assumed (in both the reference and decarbonisation case) that R&D is successful on key technologies (notably, batteries), the technology diffusion is rapid and Italy has the potential to absorb knowledge produced elsewhere at a low cost (particularly important for the electric vehicles industry of Italy).

3. **CCS gas technology** becomes commercial available after 2030.

These three conditions enable Italy to sustain or grow market share in relevant sectors – notably vehicles manufacturing – as they decarbonise. The macroeconomic implications for Italy with and without access to such low cost financial resources[3] are presented in Figures 3 and 4. Due to its current debt, in the reference case Italian GDP growth is projected to slow and not recover until after 2030. Low carbon investment, given the financing conditions indicated, means that GDP starts to recover from 2025 due to the increased investment, but the need to pay back the long-term loans smooths the resulting GDP growth rate over the decades to 2050.

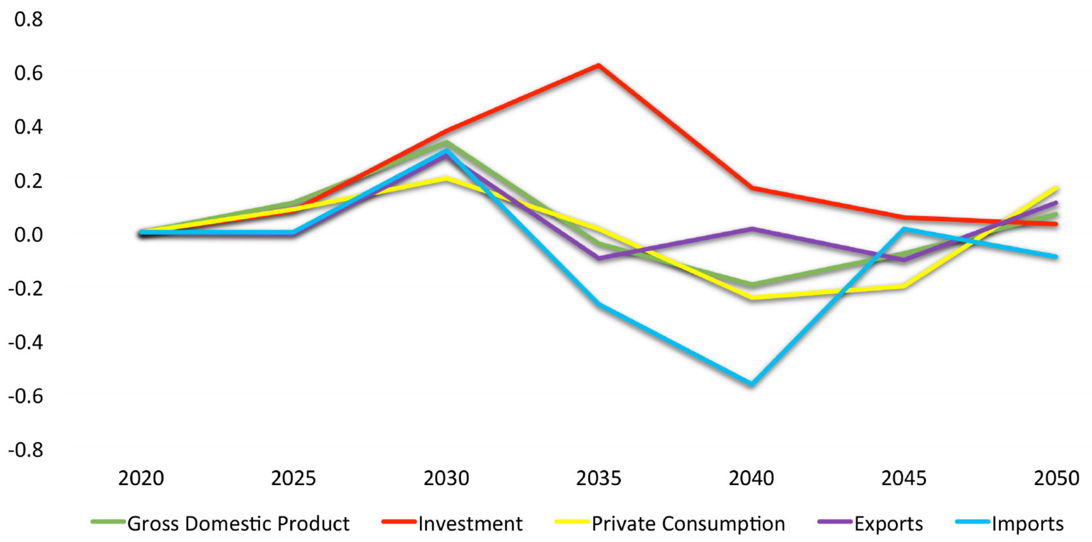
Figure 3: Italy, GDP annual growth rate in a decarbonisation scenario



Source: GEM-E3-WIN

[3] *In the self-financing scenario it is assumed that Italian firms have no access to additional than the reference financial resources and need to cancel out other investments in order to perform energy decarbonising investments*

Figure 4: Italy, change in macroeconomic indicators in a deep decarbonisation scenario



Source: GEM-E3-WIN

The other macroeconomic indicators, in terms of investment and consumption, imports and exports, are shown in Figure 4, telling a consistent story: one to two decades of increased investment help to lift the Italian economy, increasing both imports and exports, which then decline as the transition matures; the Italian economy is then significantly less dependent on energy imports (17 % reduction of energy imports from reference over the 2020-2050 period), and becomes a supplier and exporter of clean energy products (like electric vehicles) which helps to pay back the loans on the investment, leaving the Italian economy in the long run at least as well off as in the base case.

The key sectors that contribute to the Italian GDP growth through exports (are the equipment manufacturing and transport equipment. GHG emissions in the Italian power generation system are reduced mainly by the deployment of Wind (less for PV) and by the use of CCS gas.

Thus, the results suggest that the low carbon transition (Italy reduces GHG emissions by ~60 % in 2050 from reference levels) does offer macroeconomic opportunities over the coming decade, if there is a supportive and consistent investment environment to attract low-cost capital financing of low carbon assets. The low carbon transition is not a “free lunch” – the lending that supports the wave of capital investment has to be paid for over subsequent decades - but the long-run costs are negligible and, given recent trends in the declining cost of renewables, could well be net positive especially if Italy succeeds in acquiring market shares in the production of clean energy technologies and electric vehicles.

Our analysis could not directly link policies to their impact on the cost of capital; the link, rather, is inferred. Given its existing level of public debt, Italy clearly cannot finance the low carbon transition in both energy and transport sectors from public finance alone. If it is to cut emissions by more than 60% by 2050, it needs to attract private investment. Lowering the cost of such finance, through the kinds of policies in both financial sectors and the relevant demand sectors as articulated in section 1 of this paper, is necessary to make the investments attractive; and by doing so, the lower cost of capital also makes the transition macro-economically beneficial, giving an investment and GDP boost to the Italian economy over the next couple of decades.

This is not equivalent to saying that the Italian economy needs to become like the German one – the needs are more specific. Providing Italy can maintain its role as a significant manufacturer in the transition (notably in electric vehicles), the investment issues are more sector-specific, and investor confidence could derive from both stabilising Italian energy/climate policymaking (avoiding the kind of rapid and predicted changes seen in feed-in tariffs), and from embedding this in wider EU policy on both climate change and financial market governance. The Energy Union governance framework, adopted in December 2017, could be a useful step on such a road.

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Green growth and win-win strategies for sustainable climate action (GREEN-WIN)

The GREEN-WIN Project identifies, develops and critically assesses win-win strategies, green business models and green growth pathways that bring short-term economic benefits, while also supporting mitigation and adaptation goals within the broader sustainable development agenda.

Work programme

↘ At national levels, GREEN-WIN analyses win-win opportunities that arise through integrating policies across different sectors, and advances state-of-the-art macro-economic models in order to identify green growth pathways.

↘ At local levels, GREEN-WIN carries out action research case studies to develop green business models and enabling environments in the following three areas: i) coastal flood risk management in Jakarta, Kiel, Rotterdam and Shanghai; ii) transformations in urban systems in Barcelona, Istanbul, Shanghai and Venice; and iii) energy poverty and climate-resilient livelihoods with case studies in India, Indonesia and South Africa.

↘ Cutting across both levels, GREEN-WIN investigates financial products and policies, as well as financial system reforms that redirect financial flows towards sustainability and climate action.

↘ All of these activities are embedded in an open dialogue between research institutes, international organisations, business, and civil society that co-develops shared narratives around win-win strategies, business opportunities and green growth pathways

Project partners

Global Climate Forum (GCF), Germany (coordinator) | The Institute of Environmental Sciences and Technology, Autonomous University of Barcelona, Spain | E3-Modelling, Greece | Environmental Change Institute, Oxford University, UK | Ecole d'Economie de Paris, France | University College London, UK | The Ground_Up Association, Switzerland | Stichting Deltares, The Netherlands | Institute for Advanced Sustainability Studies, Germany | Global Green Growth Institute, Republic of Korea | Jill Jaeger, Austria | European Centre for Living Technology at Università Ca' Foscari Venezia, Italy | Institute of Environmental Sciences at Boğaziçi University, Turkey | Universtitas Udayana, Udayana University, Indonesia | University of Cape Town, South Africa | 2° investing initiative, France | Sustainability and Resilience, Indonesia

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