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The EU Sustainability Taxonomy: a Financial Impact Assessment

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Abstract

The European Commission set up a Technical Expert Group on Sustainable Finance (TEG) to support the implementation of the Commission's Action Plan on Financing Sustainable Growth. Among other tasks, the TEG was mandated to develop recommendations for technical screening criteria regarding economic activities that make a substantive contribution to climate change mitigation or adaptation, i.e. the so-called Taxonomy.

This report carries out a financial impact assessment of the Taxonomy. To do so, we first provide an overview of available estimates of additional investment, which is needed to achieve the targets associated with the low-carbon transition under various scenarios, at the macroeconomic level.

Then, we focus on the financial dimension. In particular, we use security-by-security data covering the whole European bond and equity markets to provide a picture of where European financial markets stand with respect to the low-carbon transition. In this respect, we also provide estimates of financial investments currently supporting Taxonomy-eligible activities.

Finally, we estimate the additional financial investment needed to allow the EU to reach its targeted reduction in carbon emissions. We conclude that the increased financial investments towards relevant sectors appear to be within reach.

1 Introduction

Sustainable development and the protection and improvement of the quality of the environment are core values of the European Union (EU) and recognized by EU laws and treaties. The Treaty of the Functioning of the European Union (TFEU) requires all proposals by the Commission to include a high level of environmental protection.[1]

The EU has set targets for reducing its greenhouse gas (GHG) emissions progressively up to 2050, with specific milestones in 2020 and 2030. The EU is currently on track to meet the targets for 2020.[2] The European Council agreed on climate and energy targets for 2030 in 2014.

At the end of 2016, the European Commission appointed the High-Level Expert Group (HLEG) on Sustainable Finance with a mandate to recommend financial reforms on which to base the EU strategy on sustainable finance. The group, delivered a final report in January 2018, including eight key recommendations and several cross-cutting and sector-specific recommendations to align the financial system with sustainability goals. The HLEG's first recommendation was to 'establish and maintain a common sustainability Taxonomy at the EU level'.[3]

Building on the HLEG's recommendations, the European Commission published in March 2018 its Action Plan on financing sustainable growth. The Action Plan describes the EU strategy for sustainable finance and is part of the implementation plan of Article 2(1)(c) of the Paris Agreement, relating to the alignment of financial flows with global climate goals and the UN 2030 Agenda for Sustainable Development.

As highlighted in the Action Plan, achieving the goal of re-orienting capital flows towards sustainable investments should be underpinned by an EU classification system that provides a common language on what constitutes sustainable activities. So far, there was no EU classification system for sustainable economic activities and the existing market-based practices are not necessarily aligned with EU environmental and sustainability policy objectives. The absence of commonly agreed principles and metrics for assessing if economic activities are environmentally sustainable is generally considered to hinder the redirection of capital towards more sustainable economic activities.[4] The approach for identifying sustainable economic activities and instruments is scattered among Member States and financial institutions identify sustainable economic activities and sustainable

[1] Article 11 of the Treaty provides that 'Environmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities, in particular with a view to promoting sustainable development'. Article 114 furthermore requires the Commission to 'take as a base a high level of protection' concerning health, safety, environmental protection and consumer protection. Under Article 191, EU policy on the environment shall contribute to pursuit of the following objectives: i) preserving, protecting and improving the quality of the environment ii) protecting human health iii) prudent and rational utilisation of natural resources iv) promoting measures at the international level to deal with regional or worldwide environmental problems, particularly combating climate change.

[2] https://ec.europa.eu/clima/policies/strategies/progress_en.

[3] https://ec.europa.eu/info/publications/180131-sustainable-finance-report_en.

[4] See in this regard the Commission Staff working Document Accompanying the document Proposal for a Regulation of the European Parliament and of the Council on the establishment of a framework to facilitate sustainable investment (http://data.consilium.europa.eu/doc/document/ST-9348-2018-ADD-2/EN/pdf).

investable assets on a voluntary basis. An EU taxonomy is therefore key to ensure consistency, providing the basis for further policy action in the area of sustainable finance, including standards and labels.

The Technical Expert Group on Sustainable Finance (TEG) was set up to assist the European Commission to implement the Commission's Action Plan. The TEG was mandated by the European Commission to develop recommendations for technical screening criteria regarding economic activities that make a substantive contribution to climate change mitigation or adaptation. To be Taxonomy-eligible, economic activities should also avoid significant harm to the following further European Union environmental objectives: i) sustainable use and protection of water and marine resources, ii) transition to a circular economy, waste prevention and recycling, iii) pollution prevention and control, iv) protection of healthy ecosystems. The TEG included three other sub-working groups, including one to develop a Green Bonds Standard that would link to the Taxonomy, one on corporate sustainability and climate related disclosures, including disclosure guidelines in relation to the Taxonomy, and one on investment benchmarks.

The development of the Taxonomy relied on the definition of a sector framework. The NACE industrial classification system has been adopted by the TEG as it was established by EU law[5] and is compatible with international and Member State frameworks. It is comprehensive in its coverage of the economy, is used by EU institutions such as Eurostat and is also already used by some financial institutions. In some areas, however, NACE demonstrated to be insufficient, requiring additional categories ensuring further granularity.

The economic activities considered by the TEG have been selected based on their importance for climate change mitigation. Owing to data availability issues, only limited analysis has been conducted for climate change adaptation and the broader environmental objectives set by the Taxonomy.

The work undertaken by the TEG reflects the principles outlined in the proposed Regulation (May 2018)[6], as well as additional principles adopted by the TEG which follow the technical work undertaken. In this regard, for an action to meet the definition of an "environmentally sustainable economic activity" and thus be considered Taxonomy-eligible, it must:

1. Contribute substantially to one or more of the environmental objectives;

2. Do no significant harm to any other environmental objective;

[5] Regulation (EC) No 1893/2006 of the European Parliament and of the Council of 20 December 2006 establishing the statistical classification of economic activities NACE Revision 2 and amending Council Regulation (EEC) No 3037/90 as well as certain EC Regulations on specific statistical domains (OJ L 393, 30.12.2006, p. 1).

[6] The Proposal for a regulation on the establishment of a framework to facilitate sustainable investment identifies six environmental objectives for the purposes of the Taxonomy (Article 5): Climate change mitigation; climate change adaptation;.sustainable use and protection of water and marine resources; transition to a circular economy, waste prevention and recycling; pollution prevention and control; and protection of healthy ecosystems.

3. Comply with minimum social safeguards (under the draft regulation, these are defined as ILO core labour conventions); and

4. Comply with the technical screening criteria.

The technical screening criteria can be qualitative or quantitative, or both, and contain thresholds where possible. The criteria build upon EU labelling and certification schemes, carbon footprint methodologies and statistical classification systems, where appropriate.

The TEG proposal is not a legislative act, but will be the basis for a proposed regulation[7] which will enable the Commission to establish technical screening criteria through a series of delegated acts.

The TEG was also asked to carry out an assessment of the impact of the Taxonomy. The impact assessment is an important forward-looking tool with regard to the development of policy action by the European Commission. It assesses if future legislative or non-legislative EU action is justified and how such action can best be designed to achieve desired policy objectives. To do so, impact assessments must identify and describe the problem to be tackled, establish objectives, formulate policy options, assess the impacts of these options and describe how the expected results will be monitored.[8] In other words, the impact assessment provides an objective assessment of Commission's proposals based on data gathering and evidence.

The impact assessment foreseen in the TEG mandate covers the economic, environmental dimensions and, notably, the financial dimension. This task follows from one of the broader objectives of the Taxonomy, which is to redirect financial flows to make them consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. To support the work of the TEG in this respect, we have developed an analysis based on financial market data, which is presented in this report, and which is input to the broader impact assessment. In particular, this report focuses on the financial dimension and estimates the potential impact of the Taxonomy on selected segments of the European financial market.

Our study first provides an overview of available estimates of additional investment, which is needed to achieve the targets associated with the low-carbon transition under various scenarios. These latter are designed at the macro level, i.e. considering the relevant economic sectors, such as energy, transport and buildings, at an aggregate level. We use these estimates as a macro framework for the analysis we carry out on financial market data, namely individual securities issued by individual firms. By doing so, we ensure consistency between our estimated financial impacts and the investment needs estimated at the macroeconomic level. We also provide our own estimate of investment needs for the transition to a low-carbon electricity production, based on a novel top-down approach.

[7] Article 16.

[8] Better regulation guidelines, European Commission, 2017.

The central part of the report focuses on the financial dimension. In particular, we use security-by-security data covering the whole European bond and equity markets to provide a picture of where European financial markets stand with respect to the low-carbon transition. Together with data on each security, we also have financial holdings for all European institutional sectors, also disaggregated at the security level. We focus on securities issued by EU non-financial corporations. Based on the NACE code of the issuer company, we first aggregate outstanding securities by so-called "climate-policy-relevant sector". These are economic sectors that build on NACE codes but are better suited for sustainability analysis, and broadly overlap with the sectors used for the estimation of investment needs at the macro level. We estimate that 37% of the outstanding equity and 33% of the outstanding bond amounts are associated with activities that belong to climate-policy-relevant sectors. In terms of holders, the exposure of institutional sectors to firms active in climate-policy-relevant sectors varies from around 30% to 48%. In a second step, we provide an estimate of the outstanding market capitalization and bond amount that can be associated with economic activities covered by the Taxonomy. Since the Taxonomy focuses on a comparatively small set of economic activities, as explained above, these amounts are also relatively small. As a last step, we estimate the outstanding NFC bond amount and market capitalization associated with Taxonomy-eligible activities, i.e. the subset of taxonomy-considered activities that satisfy the taxonomy thresholds. To do so, we follow the TEG reasoning and criteria as closely as possible. We cross-check our estimates with outstanding green bond amounts based on Eikon data and from the Climate Bond Initiative, as well as with estimates based on FTSE Russell Green Revenues, concluding that our estimates are reasonable and suggest huge potential for green bonds as a tool to finance the low-carbon transition.

In the last part of the report, building on the analyses carried out in the first two parts, we estimate the additional financial investment needed to fill the gap. Estimates vary across sectors and scenarios. In general, however, the increased financial investments towards relevant sectors appear to be within reach, compared to the current size of the corporate bond market and outstanding loans to NFCs. Even in the most stringent scenario (EUCO+40), estimates show that the (green) bond and loan issuance would increase by around 4.9% in the energy-intensive sector and by 6.0% in the transport sector.

The report isstructured as follows. The next section provides an overview of existing estimates of additional investment needs. In this section we also propose an alternative methodology to estimate investment needs for the low-carbon transition in the electricity sector. In Section 3 we assess where European capital markets stand with respect to sustainable financial investment, provide a quantification of the activities covered by the Taxonomy in terms of market share, as well as an estimate of the potentially Taxonomy-eligible market share, by sector. Finally, in Section 4 we take some of the macroeconomic and environmental scenarios described in

Section 2 as a benchmark, and derive the associated estimates for the financial impact.

2 Overview of available estimates of additional investment needs

This section takes stock of available estimates of the investment needs in the EU and globally, necessary to achieve targets associated with the low-carbon transition and other sustainability objectives. It starts from the reports specifically related to the EU2030 targets and the scenarios developed by the EC. It then provides an overview of reports on global estimates carried out by international agencies. It finally compares with results from the academic literature.

2.1 Studies based on EU 2030 Targets and EC scenarios

In order to estimate to financial impact of the EU Taxonomy, the analysis considers the set of relevant scenarios previously elaborated by the EC in assessing the progress towards the EU 2020 and EU 2030 targets for climate and energy. The Reference Scenario 2016[9] (E3MLab and IIASA 2016), abbreviated as Ref2016 in the following, represents the *baseline scenario*. The set of EUCO scenarios[10] (EC 2016 SWD (2016) 405 and EC 2016 SWD (2016) 418; Capros et al. 2018) consider policies of varying stringency towards the 2030 targets. A review was done of the results of a series of reports that analyse the above scenarios focusing on the same set of economic sectors, i.e. utility (electricity generation and grid), industry, transport and buildings. This allows to compare investments needs in the EUCO scenarios relative to the Ref2016. Note however, that these sectors are not defined in terms of the Eurostat NACE codes and thus some additional work and assumptions are needed in order to map them to other relevant sector classifications discussed later on. Table 1 summarizes the targets and scenarios that are relevant to this section.[11]

Table 1. EU Targets, Reference scenario and EUCO scenarios

Targets	**Scenario**

[9] The scenario is described in detail in E3MLab and IIASA 2016, "Technical report on Member State results of the EUCO policy scenarios", https://ec.europa.eu/energy/sites/ener/files/documents/20170125_-_technical_report_on_euco_scenarios_primes_corrected.pdf

[10] The EUCO scenarios were elaborated in the EC Impact Assessments of the EU2030 framework conducted in 2016, see EU Commission 2016, SWD (2016) 405 and 418.

EU Commission 2016, SWD(2016) 405 final, "COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on Energy Efficiency" https://ec.europa.eu/energy/sites/ener/files/documents/1_en_impact_assessment_part1_v4_0.pdf

EU Commission 2016, SWD(2016) 418 final, "COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (recast)" https://ec.europa.eu/energy/sites/ener/files/documents/1_en_impact_assessment_part1_v4_418.pdf

[11] EU 2050 Targets are provided for completeness, though not used in the scenarios.

EU 2020 Targets • GHG emission reduction: 20%; • Renewable energy share (RES): 20%; • Energy efficiency improvements: 20%.	**Ref2016**: takes into account policies until 2015, it assumes that 2020 targets are achieved. Beyond 2020, no additional RES targets are set, no additional policy support is modelled. The EU 2030 targets are not achieved.
EU 2030 Targets • GHG emission reduction: 40%; • Renewable energy share: 27%; • Energy efficiency improvements: 27%.	**EUCO27, EUCO30, EUCO+33, EUCO+35, EUCO+40:** A set of scenarios of increasing stringency that achieve the EU 2030 targets, with different margins and pathways. The scenarios assume a range of policies including: revised EU ETS; policies facilitating renewables energy targets in the electricity, heating & cooling and transport sectors; energy efficiency policies in the buildings sector via e.g. increasing the rate of renovation, facilitating access to capital for investment in thermal renovation of buildings; ecodesign standards banning the least efficient technologies.
EU 2050 Targets • GHG emission reduction: at least 80%; • Renewable energy share: at least 80% in electricity; • Energy efficiency improvements: no quantitative target.	

The **EU Reference Scenario 2016** is elaborated and analysed in E3M-Lab and IIASA (2016)[12]. It takes into account the EU policies adopted until 2015 and assumes that the EU2020 targets are achieved. It assumes that beyond 2020 no targets are set for Renewable Energy Sources (RES) and that no additional relevant policy is implemented.[13] The report estimates the investment needs in the sectors mentioned earlier. In the analysis, the level of investment taking place in the Ref2016 scenario (see Table 2) does not allow to achieve the EU 2030 targets.

The **Impact Assessments EC 2016 SWD (2016) 405[14] and EC 2016 SWD (2016) 418[15]** analyse the EUCO scenarios and the Ref2016 scenario

[12] E3M-Lab and IIASA (2016). "EU Reference Scenario 2016 Energy, transport and GHG emissions Trends to 2050". https://ec.europa.eu/energy/sites/ener/files/documents/20160713_draft_publication_REF2016_v13.pdf

[13] Notice that, the Ref2016 scenario "does not predict how the EU energy, transport and climate landscape will actually change in the future. It provides a model-derived simulation of one of its possible future states given certain conditions. In particular, it assumes that the legally binding GHG and RES targets for 2020 will be achieved and that the policies agreed at EU and Member State level until December 2014 will be implemented".

[14] EU Commission 2016, SWD(2016) 405 final, "COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on Energy Efficiency" https://ec.europa.eu/energy/sites/ener/files/documents/1_en_impact_assessment_part1_v4_0.pdf

[15] EU Commission 2016, SWD(2016) 418 final, "COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Proposal for a Directive of the European Parliament and of the

in terms of investment needs in the sectors considered. The two reports focus on the aspects of renewable energy and energy efficiency, respectively. They elaborate a set of scenarios, named as EUCO27, EUCO30, EUCO+33, EUCO+35, EUCO+40, which achieve the EU 2030 targets with different margins and along different pathways, by means of policies of varying stringency. The scenarios assume a range of policies including: revised EU ETS; policies facilitating renewables energy targets in the electricity, heating & cooling and transport sectors; energy efficiency policies in the buildings sector via e.g. increasing the rate of renovation, facilitating access to capital for investment in thermal renovation of buildings; ecodesign standards banning the least efficient technologies. The evolution of the economic sectors is modelled by means of computable partial-equilibrium model PRIMES (Capros et al. 2018). Table 2 reports the investment needs estimated in EC 2016 SWD (2016) 405 across the scenarios. The investment gap of each EUCO scenario is computed relative to Ref2016. In particular, the investment gap in the EUCO30 relative to Ref2016 amounts to €177 billion.

Table 2. Investment needs across sector and scenarios reported from EC 2016 SWD (2016) 405, Table 22 p. 66

	Investment needs (€ bn)					
Sector	Ref2016	EUCO27	EUCO30	EUCO+33	EUCO+35	EUCO+40
Electricity grid	34	39	36	34	31	26
Gap to Ref2016		5	2	0	-3	-8
Power generation	33	42	42	40	37	36
Gap to Ref2016		9	9	7	4	3
Industry	15	17	19	24	29	51
Gap to Ref2016		2	4	9	14	36
Transport	705	731	736	729	733	740
Gap to Ref2016		26	31	24	28	35
Buildings - tertiary	23	40	68	119	157	257
Gap to Ref2016		7	45	96	134	234

Council on the promotion of the use of energy from renewable sources (recast)"
https://ec.europa.eu/energy/sites/ener/files/documents/1_en_impact_assessment_part1_v4_418.pdf

Buildings - households	127	168	214	286	337	455
Gap to Ref2016		41	87	159	210	328
Total	**938**	**1037**	**1115**	**1232**	**1324**	**1565**
Total gap to Ref2016		**99**	**177**	**294**	**386**	**627**

The study **"Assessing the state-of-play of climate finance tracking in Europe" (2017) by Trinomics, commissioned by the European Environment Agency (EEA)[16],** carries out an analysis on the state of information at 2017 regarding estimated investment needs at the EU level and for selected member states. It further conducts a survey of availability and accessibility of climate finance relevant data at a country level for 39 EEA member states[17], to assess investment needs until 2030.

The report **"Restoring EU competitiveness" (2016) by the European Investment Bank (EIB)[18]** does not consider the EU 2030 climate targets explicitly but it analyses the challenges of the low-carbon transition from the point of view of competitiveness. In practice, this report combines the EC estimates of investment needs with own elaborations, focusing on sectors that are critical to Europe's competitiveness. In particular, it provides estimates of investment needs and the investment gap for the water and waste sector (see Table 3).

Table 3. Estimates of sectoral investments gap for the EU by the EIB.

Sector	Technology	Current (€ bn)	Investment Needs (€ bn)	Gap (€ bn)	
Transport	Modernizing urban transport to meet global benchmarks	40	80	40	**80**
	Ensuring sufficient capacity in interurban transport	40	80	40	
Water & waste	Water security, including flood risk management	2	15	13	**90**
	Compliance rehabilitation of Europe's water infrastructure	30	75	45	
	Enhancing waste management/materials recovery	3	8	5	

[16] Trinomics 2017, "Assessing the state-of-play of climate finance tracking in Europe - Final Report". https://trinomics.eu/wp-content/uploads/2017/07/State-of-play-of-European-climate-finance-tracking-published-6-July-2017.pdf

[17] These include 28 EU Member States, together with Iceland, Liechtenstein, Norway, Switzerland, Turkey, Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Kosovo, Montenegro and Serbia.

[18] European Investment Bank (2018). "Restoring EU competitiveness 2016 updated version" https://www.eib.org/attachments/efs/restoring_eu_competitiveness_en.pdf

	Additional needs for resilient and efficient urban infrastructure	13	40	27	
Energy	Upgrading energy networks (gas and electricity)	47	64	18	**100**
	Energy efficiency in buildings and industry	42	112	70	
	Power generation, including renewables	41	53	12	
	Total	258	527	**270**	

The **"Action Plan: Financing Sustainable Growth" (2018) by the European Commission**[19] discusses the key challenges for the sustainability transition, as well as the main milestones of the EC agenda. It combines the previous estimates conducted by the EC for the investment needs to achieve the 2030 targets with the EIB estimates for the investment needs to restore competitiveness (for the water and waste sector). As shown in Table a.3, to reach energy and climate goals, an additional funding of €180 billion per year is needed with respect to the current level of investments (i.e. the Ref2016 benchmark, see above). When considering the water and waste sector as a well, the investment gap rises to €270 billion. More in detail, current annual investments in the transport sector amount to €80 billion and additional €80 billion are needed to meet the targets. As for the water and waste sector, current investments amount to €48 billion per year and additional €90 billion are needed. For the energy sector, €130 billion are currently invested each year, while additional investment needs are estimated at €100 billion per year.

2.2 Studies based on IEA and IRENA scenarios

In the report **"Perspectives For The Energy Transition: Investment Needs For A Low-carbon Energy System" (2017) by the International Energy Agency and International Renewable Energy Agency (IEA and IRENA)**[20] joined forces to shed light on how the energy sector should develop, at the global level, in order to achieve the objective set out in the Paris Agreement.

Table 4. Overview of the targets, scenarios and models considered by IEA and IRENA.

Target		**Scenarios and models**

[19] EU Commission (2018). "Action Plan: Financing Sustainable Growth" https://ec.europa.eu/info/publications/180308-action-plan-sustainable-growth_en

[20] IEA and IRENA (2016). "Perspectives for the energy transition: Investment needs for a low-carbon energy system" https://www.irena.org/publications/2017/Mar/Perspectives-for-the-energy-transition-Investment-needs-for-a-low-carbon-energy-system

Limiting the global mean temperature rise to well below 2°C with a probability of 66%. Between 2015 and 2100, the CO_2 budget estimation amounts to 880 Gt.	IRENA	• Renewable Energy Roadmap (**REmap**) energy mixes complemented with the **E3ME**, a global macro-econometric model model that covers the global economy. • It represents a techno-economic assessment of energy system developments on a country level, for **all G20 countries**. • Two scenarios: The **Reference Case** (also called the baseline or business-as-usual), and The **REmap Case** (also called the decarbonisation case) an accelerated renewables case based on decarbonisation targets.
	IEA	• The model consists of three main modules: **final energy consumption** (residential, services, agriculture, industry, transport and non-energy use); **energy transformation** (including power generation and heat, refinery and other transformation); and **energy supply**. • Detailed **sector-by-sector** and **region-by-region** projections for the World Energy Outlook (**WEO**) scenarios.

As summarized in Table 5, for the power generation, transport, buildings and industry (including heating and cooling) sectors the IEA estimates the investment gap to be $1.7 trillion yearly until 2050, which is obtained as the difference between the $3.5 trillion required and the $1.8 trillion invested in 2015. In the same report, the International Renewable Energy Agency estimates the same overall investment needs until 2050, i.e. $116 trillion, which indeed corresponds to a yearly investment of $3.5 trillion over 33 years. However, the IEA estimates the investment gap to be lower, at $0.900 trillion per year, i.e. $29 trillion in total. According to updated estimates by IRENA, reported in its **"Global Energy Transformation" (2018)**[21], the investment needs increased by $4 trillion to $120 trillion, but the investment gap decreased by $2 trillion to $27 trillion overall by 2050.

Table 5. Estimates of current investment and investment needs at the global level by IEA and IRENA

	Current investment ($ tn)	**Investment needs ($ tn)**	**Investment gap ($ tn)**

[21] IRENA (2018). "Global Energy Transformation: A Roadmap to 2050 (2018 edition)" https://www.irena.org/publications/2018/Apr/Global-Energy-Transition-A-Roadmap-to-2050

IEA	1.8	3.5	1.7
IRENA (2017)	2.6	3.5	0.9
IRENA (2018)	3.0	3.6	0.8

2.3 Academic studies

Turning to academic studies, while many works study the economic implications of reaching the 2030 EU climate targets, only some discuss investment needs and gaps. For instance, **Duscha et al. (2016)**[22] assess if RES are able to positively contribute to the three objectives of European energy policy: combating climate change, improving security of supply and resulting in economic benefits (i.e., job creation and economic growth). **Pfeiffer et al. (2016)**[23] review the global stock of infrastructure which, if operated to the end of its economic life, implies a global mean temperature increase of at least 2°C. The three contributions summarized below discuss investment needs across climate policy scenarios.

Capros et al. (2018)[24] leverages on the PRIMES energy systems to present a set of scenarios that have been used to contribute to the Impact Assessment work by the European Commission in 2016. While the impact assessment studies mainly use two policy scenarios, named EUCO27 and EUCO30, this scientific paper illustrates a systematic analysis across the six different climate policy scenarios described before. The scenarios have been defined starting from a set of climate targets for 2030 and beyond: reducing GHG emissions, increasing energy efficiency, and increasing the penetration of renewable energy sources in the energy system. The results show that the yearly investment gap to 2050 spans between €180 billion (in the EUCO30 scenario) and €240 billion (in the EUCO+40 scenario).

McCollum et al. (2018)[25] computes the investment needs across different climate policy scenarios by implementing a variety of Integrated Assessment Models. To do so, the authors compare the cost of the low carbon transition following three different greenhouse gas emission pathways, namely Nationally Determined Contributions, 1.5°C and 2°C.

[22] Duscha, V., Fougeyrollas, A., Nathani, C., Pfaff, M., Ragwitz, M., Resch, G., Schade, W., Breitschopf, B., & Walz, R. (2016). Renewable energy deployment in Europe up to 2030 and the aim of a triple dividend. Energy Policy, 95, 314-323.

[23] Pfeiffer, A., Millar, R., Hepburn, C., & Beinhocker, E. (2016). The '2 C capital stock' for electricity generation: Committed cumulative carbon emissions from the electricity generation sector and the transition to a green economy. Applied Energy, 179, 1395-1408.

[24] Capros, P., Kannavou, M., Evangelopoulou, S., Petropoulos, A., Siskos, P., Tasios, N., Zazias, G. & DeVita, Alessia (2018). Outlook of the EU energy system up to 2050: The case of scenarios prepared for European Commission's "clean energy for all Europeans" package using the PRIMES model. Energy strategy reviews, 22, 255-263.

[25] McCollum, D. L., Zhou, W., Bertram, C., De Boer, H. S., Bosetti, V., Busch, S., Després, J., Drouet, L., Emmerling, J., Faz, M., Fricko, O., Fujimori, S., Gidden, M., Harmsen, M., Huppmnann, D., Iyer, G., Krey, V., Kriegler, E., Nicolar, C., Pachauri, S., Parkinson, S., Poblete-Cazenave, M., Rafaj, P., Rao, N., Rozenberg, J., Schmitz, A., Schoepp, W., Van Vuuren, D. & Riahi, K. (2018). Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals. Nature Energy, 3(7), 589.

Further analyses based on the supplementary information to the paper and averaging across models, yield an annual gap in low-carbon investments in the European Union equal to $20 billion, $147 billion and $96 billion to achieve the Nationally Determined Contributions, 1.5 °C and 2°C targets, respectively.

2.4 Top-down approach to estimate investment needs in electricity production

To complement the estimates discussed in the previous subsections, in this subsection we present an alternative methodology for the estimation of investment needs for the low-carbon transition. In particular, we focus on low-carbon electricity production. In this context, investment needs can be estimated based on a simple but coherent top-down approach, which assumes constant shares of renewable energy in each country, and leverages on country and technology specific levelized cost of electricity (LCOE). In particular, we estimate the investment needs in order to convert all electricity production to renewable sources. While this is an extreme scenario, we opt for this choice for two reasons: i) it represents an upper bound of the investment needs to reach climate targets, and ii) the target level of electricity production from renewable sources depends from National Determined Contributions (NDCs) and can be very heterogeneous across countries, so any other choice would be arbitrary. The methodology can be easily adapted to compute the investment needs to reach a lower level of electricity production from renewable sources. In this section we describe the data used, the proposed methodology, and the results obtained.

2.4.1 Data

We use data from Bloomberg New Energy Finance (BNEF), in particular the *Power Sector Data by Country* and the *New Energy Outlook* databases. From the power sector data we obtain the time series of energy generation and levelized cost of electricity for each country at the technology level. From the new energy outlook we obtain the value of population and GDP of each country.[26] We focus on 2016 data given the highest coverage in terms of energy generation and LCOE.

2.4.2 Methodology

In order to compute the investment needs for the low-carbon transition, we have developed a methodology that involves the following five steps.

First, the LCOE of each technology in each country is computed as the mean of all the different sub-technologies that are present in the BNEF database (e.g., the LCOE of the "Solar" technology corresponds to the mean LCOE of "Solar PV - crystalline silicon", "Solar Thermal" and "Solar PV - crystalline

[26] Population and GDP data are also sourced from the World Bank.

silicon (with tracking)").[27] Since for many countries the LCOE is missing, for each technology we fill gaps inputing the average LCOE.

Second, the amount of electricity that is produced using renewable and non-renewable sources is computed. In particular, the set of renewable technologies considered is "Hydro", "Solar", "Wind", "Biomass & Waste", and "Geothermal". The set of non-renewable technologies includes "Fossil Fuel" and "Nuclear".

Third, for each country and renewable technology, the associated *share of electricity* produced is computed. The electricity mix is assumed to be constant during the low carbon transition. Of course, this is a rather strong assumption; however, the energy mix does at least partially depend on countries specificities such as the quality of solar radiation or geographic features (e.g. the presence of mountains and valleys for large hydro installations) and it is hence unlikely to dramatically change over time.

Fourth, the amount of non-renewable electricity that has to be substituted by each renewable technology is computed.

Finally, using the LCOE the investment needs in order to convert the production of electricity from non-renewable sources to renewable sources is estimated. In order to do so, the LCOE of each technology in each country is assumed to decrease when the installed capacity increases. Furthermore, there is a long stream of literature (e.g., Kobos ea. 2006[28]) focusing on this dynamics which is called "learning-by-doing" and it is empirically measured that for renewable energy technologies when the installed capacity doubles the LCOE drops by about 20%. For the sake of simplicity, we use electricity generation as a proxy of installed capacity. However, for each technology and country it can be argued that electricity generation is just a constant fraction of the installed capacity (*capacity factor*). For this reason, the ratio between generation and capacity does not change when the installed capacity increases. All of this means that, if the initial levelized cost of electricity $LCOE^0$ and the initial capacity C^0 are known, the levelized cost of electricity $LCOE(C)$ at a given capacity C can be written as

$$LCOE = LCOE^0 \cdot r^{\log_2\left(\frac{C}{C^0}\right)},$$

where r is the learning-by-doing coefficient, which we set to 80%. To estimate the investment needs IN to bring the renewable energy installed capacity from C^0 to C^f , the following integral has to be solved

$$IN = \int_{C^0}^{C^f} LCOE^0 \cdot r^{\log_2\left(\frac{dx}{C^0}\right)} dx.$$

It can be shown that the investment needs to increase the installed capacity from C^0 to C^f is

[27] The two BNEF databases are slightly different in terms of the technology breakdown they adopt.
[28] Kobos, P. H., Erickson, J. D., & Drennen, T. E. (2006). Technological learning and renewable energy costs: implications for US renewable energy policy. *Energy policy*, *34*(13), 1645-1658.

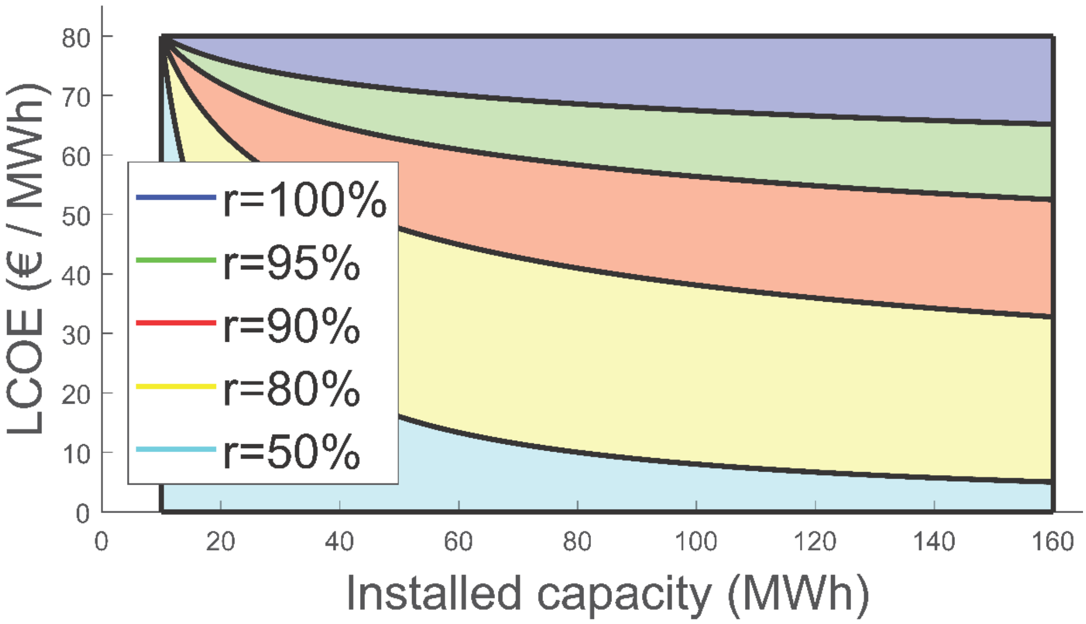
$$IN = \frac{LCOE^0 \cdot \ln 2}{\ln 2r} \cdot \left(C^f \cdot r^{\log_2\left(\frac{C^f}{C^0}\right)} - C^0 \right).$$

Notice that when r=1, the solution writes

$$IN(r=1) = LCOE^0(C^f - C^0),$$

which corresponds to the surface of the rectangle with sides C^f-C^0 and $LCOE^0$, and represents the investment needs to increase the capacity at a constant LCOE. Figure 1 shows various estimated investment needs associated with different learning-by-doing coefficients. For instance, the yellow surface represents the investment needs to increase the installed capacity from 10 MWh to 160 MWh, when the initial levelized cost of electricity $LCOE^0$ is equal to 80 and the learning by doing coefficient r is equal to 50%. In particular, an increase from 10 MWh to 160 MWh requires the installed capacity to double 4 times. For this reason, when r=50% the final LCOE corresponds to 5 €/MWh ($80\ (MWh) \cdot 0.5^4 = 5(MWh)$). The sum of the yellow, cyan and red surfaces represents the investment needs to increase the installed capacity when r is equal to 90%. Similarly, the sum of all coloured surfaces represents the investment needs to increase the installed capacity when r is equal to 100%. As shown in the last equation, this latter case corresponds to a rectangle.

Figure 1. The impact of learning-by-doing coefficients on investment needs



When available, we carry out this computation for *low*, *mid* and *high* levels of LCOE to finally obtain an estimated range for investment needs.

2.4.3 Results

Based on the approach outlined above, when disregarding learning-by-doing dynamics, investment needs for the low-carbon transition are estimated at €127 billion, €162 billion and €225 billion for the EU as a whole[29], for the *low*, *mid* and *high* LCOE levels, respectively. These figures are in line with those reported by the EIB for the energy sector as described in previous sections of this report.

Table 6 shows the share of non-renewable electricity and the investment needs to convert all of it into renewables. In addition, to put these numbers in perspective, for each country we put in relation the estimated investment needs with population and GDP. Most of the larger and developed countries require comparatively larger investments. In particular, considering the top 13 countries in terms of investment needs, about half of them are European.

While the share of non-renewable electricity produced in China (73%) is lower than in other large countries such as the United States (85%), the investment needs to convert it to renewable sources are larger ($87 vs $42 bn). This is because the Chinese population is by far larger than the US one, thus requiring more electricity. When the investment needs are weighted by population, the number for China ($63 per inhabitant) results to be about half of the one for the United States ($131). However, when weighting investment needs by GDP, China needs relatively more investments (0.7%) than the United States (0.2%). This is because US GDP is much larger than Chinese GDP.

Table 6. Top countries in terms of investment needs

Country	**Share of non-renewable electricity**	**Investment needs (bn $/year)**	**Investment needs per inhabitant ($/year)**	**Investment needs per GDP**
China	73%	87	63	0.7%
United States	85%	42	131	0.2%
Japan	84%	22	176	0.4%
India	83%	20	15	0.9%
Germany	70%	16	199	0.5%
France	81%	16	240	0.6%
Russian Federation	82%	10	69	0.8%
Spain	57%	8	171	0.6%
Poland	88%	8	198	1.6%
United Kingdom	74%	7	112	0.3%
South Africa	96%	7	119	2.3%

[29] Cyprus, Luxembourg and Malta are missing for lack of data.

Italy	58%	6	97	0.3%
Canada	35%	6	156	0.4%

Overall, based on a small set of mild assumptions, this methodology allows to estimate the investment needs to convert the electricity production to renewable energy. Our estimates are very heterogeneous across countries. Moreover, investment needs can have very different impacts on countries' balance sheets.

3 Financial markets in Europe and sustainable finance: the status quo

Against the estimates of additional investment needs described above, in this section we investigate where EU capital markets stand today in terms of funding environmentally sustainable economic activities. While 70% of debt financing for EU non-financial corporations (NFC) is currently provided by banks, developing deeper capital markets is one of the priorities for the EU. Hence, capital markets will arguably play an important role in financing the carbon transition. Moreover, we do not have access to granular enough data on bank loans to carry out a similar analysis to that we do on securities. However, acknowledging the importance of bank financing, we do also consider loans as a source of funding in the scenarios developed in the next section.

We acknowledge that also sovereign and municipalities invest in green activities. However, at this stage we focus on European NFCs. The analysis might be extended in the future. Also, it should be emphasized that even though we also provide a comparison with green bond issuance to cross-check our estimates, the focus of the analysis is economic activities and not green bonds. For this reason, we exclude financial issuers unless we can map the financial flow to economic activities that are considered under the EU sustainability taxonomy (as in case of the automotive companies).

The detailed analysis presented in this section can be regarded as a baseline scenario for EU financial markets in the absence of an EU Taxonomy.[30] Indeed, it could be argued that in this case, financial markets would not look dissimilar from today in a sustainable finance perspective. In this respect, this scenario is similar in spirit to the Ref2016 scenario described in the previous section.

3.1 Data and data treatment

Our analysis is based on confidential security-by-security databases. The main source of data for this analysis are the Eurosystem's Centralised Securities Database (CSDB) and Securities Holding Statistics Database - Sector module (SHS).[31] The former contains information on the issuer side, while the latter contains information on the holder side. The SHS data have been collected since the fourth quarter of 2013 and cover the two main types of security: debt securities and equity securities (including investment fund shares). Securities holdings include aggregated holdings by investors that are grouped into institutional sectors classified according to ESA2010 methodology. It covers holdings of investors residing in the euro area and non-resident investors' holdings of euro area securities that are deposited

[30] In this analysis, the EU composition excludes Croatia, Sweden and the UK - i.e. countries for which detailed security-by-security holding information is not stored in the ECB database – as well as Romania, which did not give us permission to use their data.

[31] The legal basis for collecting SHS data is laid down in Regulation ECB/2012/24. This Regulation is complemented by Guideline ECB/2013/7, which sets out the procedures to be followed by national central banks when reporting to the ECB.

with a euro area custodian. In addition, the analysis presented in this report also utilizes detailed information about issuance and holdings of securities by non-euro area EU countries such as Bulgaria, the Czech Republic, Denmark, Hungary, and Poland. The holding information is complemented with the CSDB that contains information such as issuer name, issuer NACE classification, and outstanding amount and precise asset type for over six million outstanding debt securities, equities and investment fund shares. We focus on debt and equity securities identified by International Securities Identification Number (ISIN) and **issued by non-financial corporations** (NFCs, according to the ESA2010 classification) resident in the EU.

For the electricity generation, primary energy and automotive sectors, we have cross-checked the NACE code associated to the security based on data obtained from annual reports, and from the Paris Agreement Capital Transition Assessment (PACTA) project. Finally, to cross-check our proposed approach to estimating the share of financial investment associated with green activities, we use the FTSE Russell Green Revenues data.

These datasets have some limitations. First, in the CSDB data, there are issuers operating in real-economy sectors that are potentially relevant for the EU taxonomy but cannot be traced back to the relevant economic sector. For example, when the issuer of a security is a holding company, it is classified under the NACE code Financial and insurance activities (namely K 64.20) or under the NACE code Professional activities etc.(M 70.10). As a result, they cannot be classified in terms of the economic sectors, nor in terms of the EU Taxonomy. Similarly, several issuers are financial subsidiaries of companies in real-economy sectors that are potentially relevant for the EU taxonomy. However, financial subsidiaries are also classified under K – Financials. As a result, also the securities issued by financial subsidiaries cannot be classified, at this stage, in terms of economic sectors, nor in terms of the EU Taxonomy. This means that the estimates of financial values of activities relevant economic sectors could increase if a reclassification based an additional data sources were carried out.

Second, for some securities the price is not available for certain dates. In these cases, the CSDB may provide estimated prices. This issue is unlikely to affect the estimates presented in this report, since they are aggregated across countries and issuers. However, it could be a source of spurious variations for smaller groups of issuers. For this reason, an analysis of growth rates of financial values of securities in specific sectors was not carried out at this stage.

With respect to the methodology, the NACE codes (4 digits) are mapped to the climate-policy relevant sectors (CPRS, Battiston ea. 2017). The CPRS classification identifies the main sectors that are relevant for climate transition risk (i.e. fossil-fuel, electricity, energy-intensive, transportation, buildings). A recent refinement of this classification provides a more granular classification of some of these sectors in terms of technologies.

The 4-digits NACE codes allow to distinguish only some of the technologies (such as transportation|roadways versus transportation|railways). In other cases, the classification into CPRS requires additional firm-level information (e.g. utilities|electricity|solar, etc.).

The list of the NACE codes that have been considered in the EU taxonomy has been compiled from the the documents publicly available from the TEG. The corresponding NACE codes are referred to as "considered in the EU Taxonomy". Table 7 provides an overview of the NACE codes that are included in the CPRS sectors as well as in the EU Taxonomy.

For each type of security considered in the analysis (i.e. equities and bonds), the data from CSDB and SHS are matched over the ISIN codes of the securities. Thanks to this matching, the holdings of the main instititutional sectors can be aggregated across NACE codes, CPRS sectors as well as EU Taxonomy coverage.[32]

Table 7. Overview of the mapping across CPRS, NACE codes and EU Taxonomy coverage

CPRS sector	NACE codes	EU Taxonomy
1-fossil-fuel	Selected codes from: • B-Mining and quarrying related to extraction of coal, gas and oil (e.g. 05.20, 06.10, 06.20, etc.) • C-Manufacturing related to refinement of coal, gas and oil (e.g. 19.10, 19.20, 20.11); • D-Electricity and gas (e.g. 35.21) • G-Wholesale related to sales of automotive fuel (e.g. 47.30) • H-transportation related to fossil-fuel via pipelines (e.g. 49.50)	Selected codes from: • B-Mining and quarrying related to extraction of iron ores (e.g. 07.10, 07.20)
2-utility	Selected codes from: • D-Electricity and gas related to production, transmission and distribution of electricity (e.g. 35.11, 35.12, 35.13) • E-Water supply etc. (e.g. 36.00, 37.00, 38.11)	Mostly considered
3-energy-intensive	Selected codes, taken from the EC classification of Carbon Leakage sectors that are not already included in the CPRS sectors fossil fuel or transportation, in particular from: • B-Mining and quarrying (e.g.07.10, 07.29, 08.91 etc.) • C-Manufacturing (about 200+ sectors, e.g. 11.01, 13.10, 15.11 etc.)	Just few are considered (e.g. 20.15, 20.20) as sectors where significant gains in energy efficiency could be realised.
4-buildings	Selected codes from: • F-Construction related to residential and commercial building construction (e.g. 41.10, 41.20, 43.22, 43.91 etc.) • I-Accommodation etc. related buildings devoted to accommodation (e.g. 55.10, 55.20) • L-Real-estate (e.g. 68.10,68.20, 68.30) • M-Professional etc, related to architectureal activities (e.g. 71.11)	Selected codes from: • F-Construction related to residential and commercial building construction (e.g. 41.10, 41.20, 43.22, 43.91 etc)

[32] The full mapping across NACE codes, CPRS and EU Taxonomy is provided at the following page: https://www.finexus.uzh.ch/en/projects/JRC_UZH_COLLABORATION.html.

5-transportation	Selected codes from: • C-Manufacturing related to manufacturing of motor vehicles, ships and trains (e.g. 29.10, 29.20, 30.11, 30.20 etc.) • F-construction related to construction of roadways, or railways (e.g. 42.11, 42.12) • G-Wholesale etc. related to sales of vehicles (e.g. 45.32) • H-Transportation etc. activities related to land, air, and sea transport (49.10, 49.20, 49.41, 50.10, 51.10, etc.)	Selected codes from: • H-Transportation etc. activities related to land, air, and sea transport (49.10, 49.20, 49.41, 50.10, 51.10, etc.)

3.2 European financial markets and climate policy relevant sectors

The EU taxonomy builds on the NACE code classification, recognizing that in several cases a more granular classification by technology is required in order to identify economic activities that can be considered sustainable. The scientific literature has pointed out that in order to assess the relevance of economic activities for with respect to climate mitigation, it is useful to consider NACE codes at the most granular level (NACE 4 digits) and to group them accordingly to the classification of Climate Policy Relevant Sectors (CPRS), developed in Battiston et al. (2017).[33] Recently, this classification has been used in the ECB Financial Stability Review.[34]

Figures 2 and 3 show the breakdown of market capitalization and outstanding bond amount, respectively, of EU issuers by NACE code (1 digit)[35] and by CPRS (level 1). The figures illustrate how the CPRS classification is complementary to the NACE codes and covering all the NACE macro-sectors included in the EU Taxonomy (A-F, H, J and L). For instance, some activities that pertain to the value chain of the transportation sector are classified in terms of NACE codes under C-Manufacturing. Regrouping the activities by CPRS allows gauging the investment more directly in relation to the climate mitigation domains. Another added value of using CPRS is that, while the sectors in the EUCO scenarios (see previous section) are not defined in terms of NACE codes, they are broadly comparable with CPRS. Hence, in the next section the CPRS classification will allow bridging between the estimation of the investment gap conducted by the EC in previous exercises and the current investments in the EU financial markets.

Figure 2. Breakdown of market capitalization by NACE (1 digit) and CPRS (level 1)

[33] Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., & Visentin, G. (2017). A climate stress-test of the financial system. Nature Climate Change, 7(4), 283.

[34] https://www.ecb.europa.eu/pub/financial-stability/fsr/special/html/ecb.fsrart201905_1~47cf778cc1.en.html#toc4

[35] NACE codes belonging to main sections from A to M are shown.

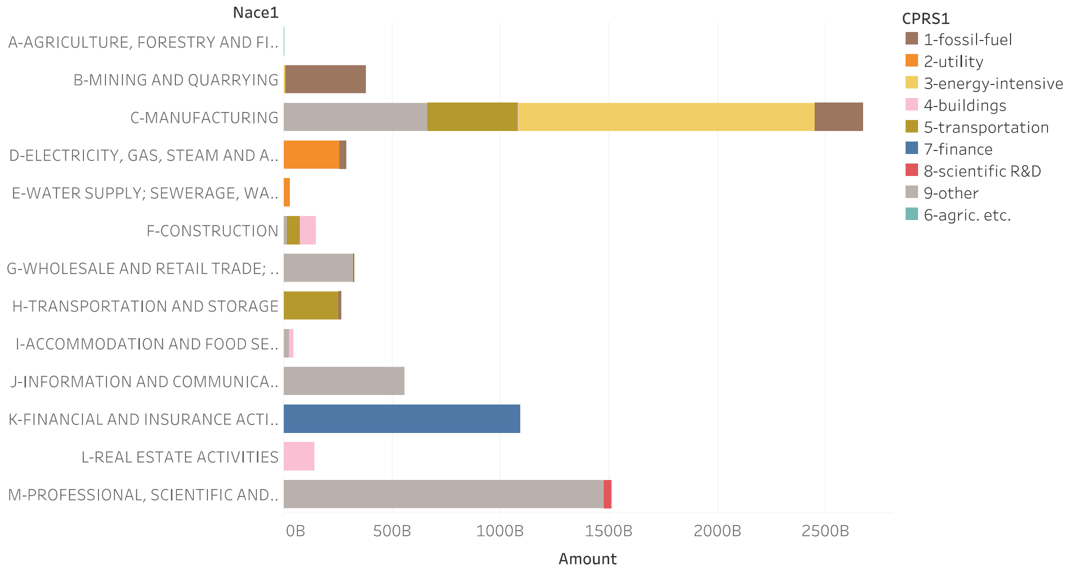
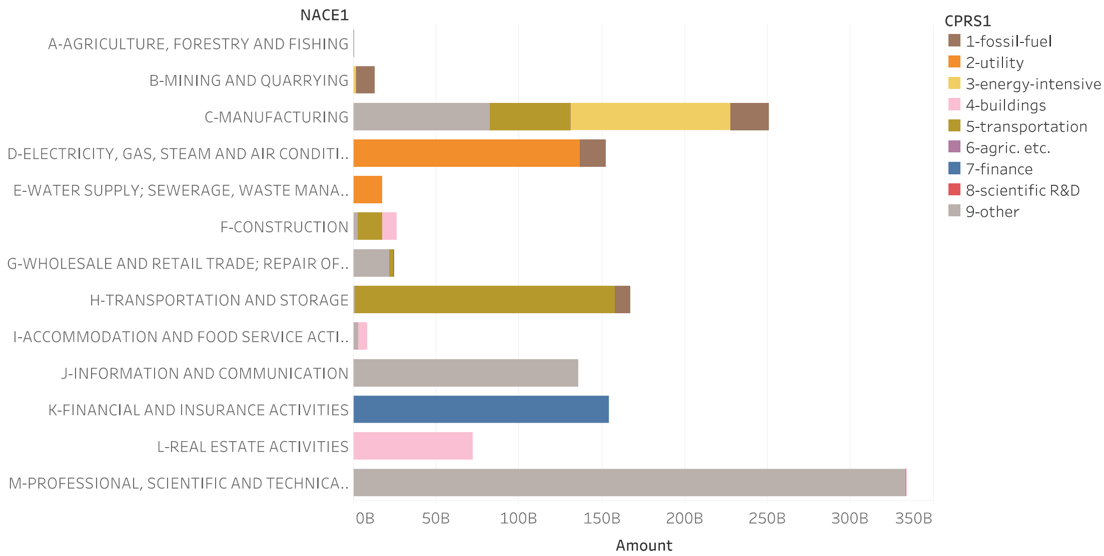


Figure 3. Breakdown of outstanding bond amount by NACE (1 digit) and CPRS (level 1)



In 2018, the total market capitalization of equity shares and outstanding amount of bonds issued by EU NFCs classified into the first six climate-policy relevant sectors (i.e. fossil-fuel, utility, energy-intensive, buildings, transportation and agriculture) is around €2864 billion and €456 billion, respectively.[36] In percentage terms, financial investments directed to firms classified into CPRS correspond to 37% of outstanding shares and 33% of outstanding bonds as reported in the table below. Table 8 provides an overview of securities (equity and bonds) issued by non-financial corporations in CPRS and in total.

Table 8. Overview of securities issued by NFCs at a sectoral level

Year 2018	Equity (€ bn)	Bonds (€ bn)

[36] CPRS are based on the NACE classification, where a firm is classified into the one NACE sector associated with its main activity. However, firms may be active into various businesses; hence one needs firm-level data for a more precise assessment of the share of investment that is directed to CPRS. Still, in the absence of segregation requirements, there is no certainty on how firms use their funding.

Values of securities issued by NFCs in CPRS sectors	2864	456
Values of securities issued by NFCs in all sectors	7786	1397

Figures 4 and 5 provide a more detailed breakdown of financial investments by showing the finer classification of CPRS level 1 and level 2 over time.

Figure 4. Breakdown of market capitalization by CPRS (level 1 and 2) over time

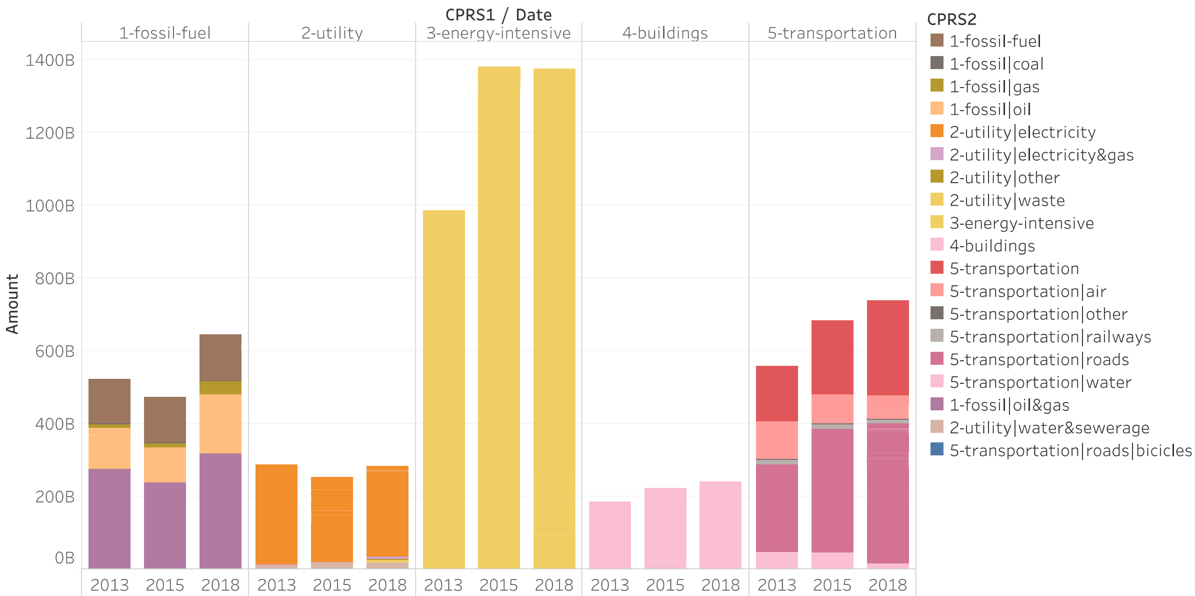
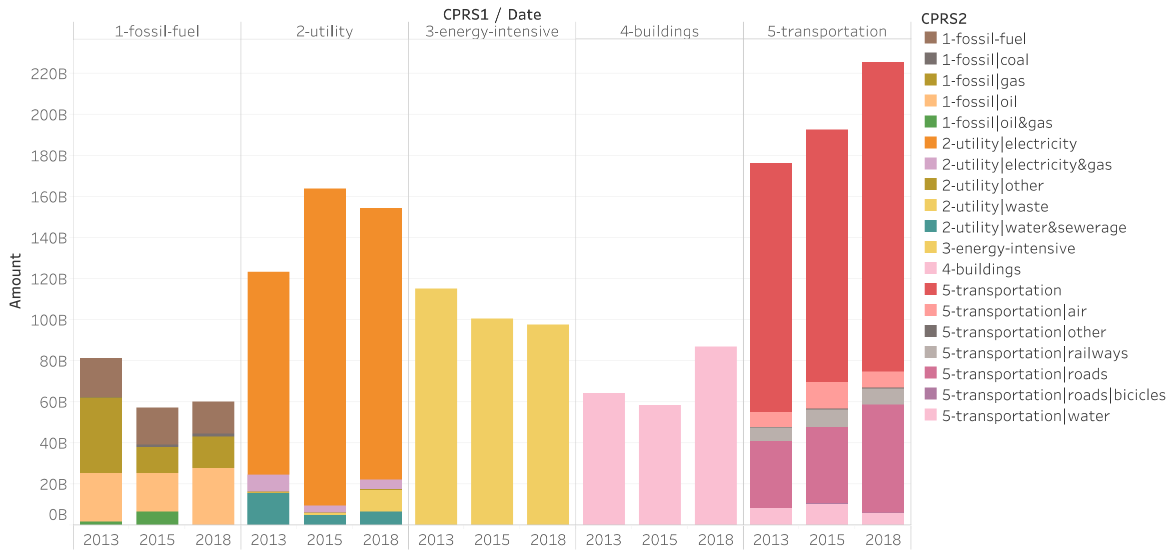


Figure 5. Breakdown of outstanding bond amount by CPRS (level 1 and 2) over time



Turning to holders, Figures 6 and 7 show the exposures (in billion and percentage) on the balance sheet of selected institutional sectors, towards NFCs active in the main CPRS sectors (i.e. fossil fuels, utility, energy-intensive activities, buildings and transport). Institutional sectors are defined following the ESA 2010 classification, namely households, NFCs, government, financial corporations, and rest of the world. From 2013 to 2018, securities holdings of institutional sectors have increased across the board. Against this background, investment into companies active in the main CPRS, including fossil fuels, has remained broadly stable in percentage terms.

Figure 6. Breakdown of exposures by institutional sector and CPRS (level 1) through equities

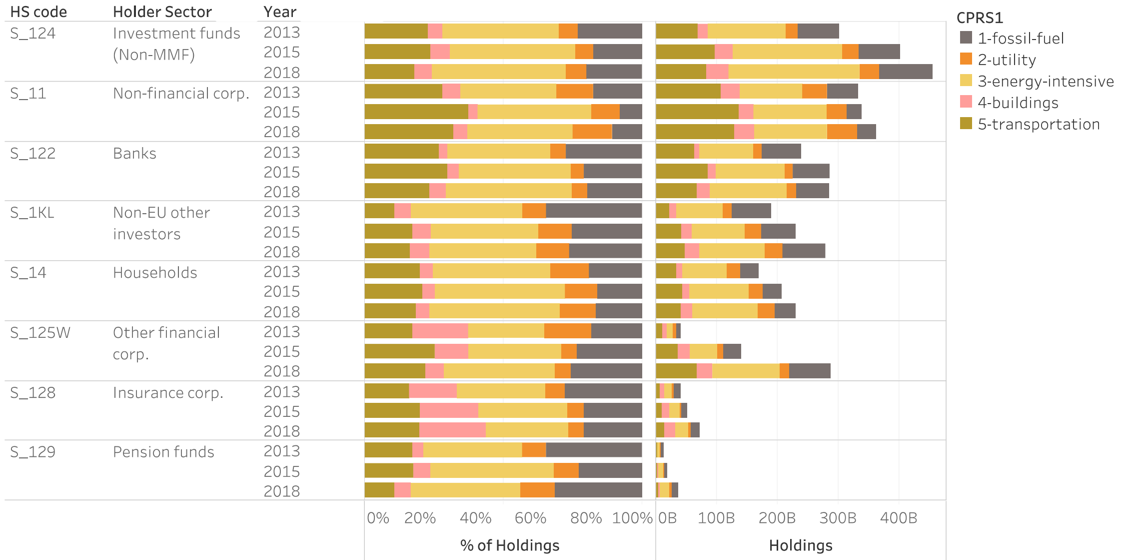
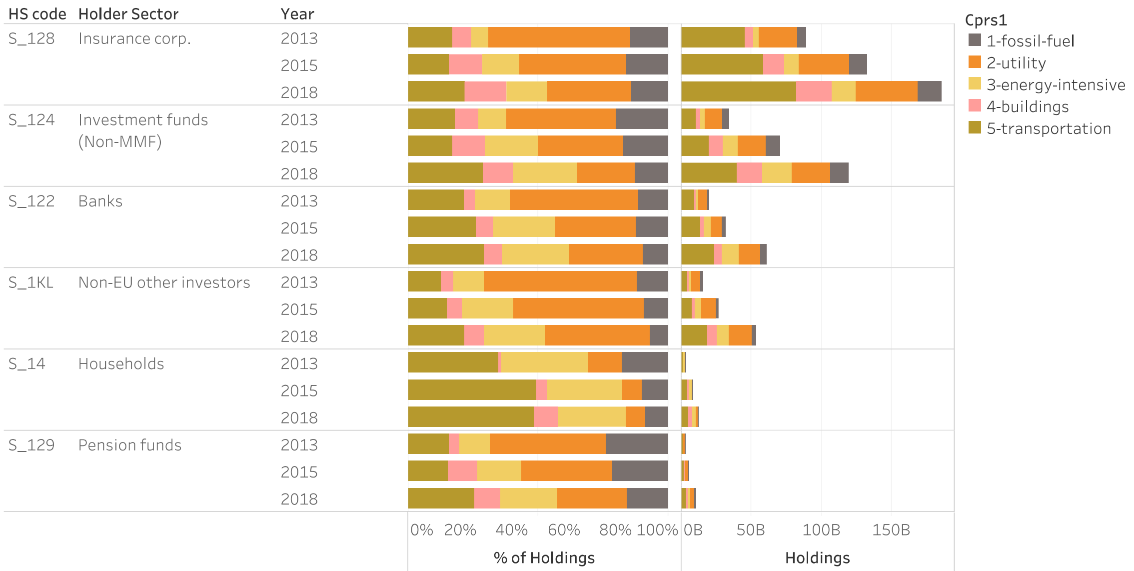


Figure 7. Breakdown of exposures by institutional sector and CPRS (level 1) through bonds



The exposures of the institutional sectors aggregated across all CPRS in 2018 are reported in Tables 9 and 10 for equity and bonds, respectively. Investment funds and non-financial corporations are the top holders of CPRS sectors in the equity market. Across institutional sectors the relative exposure to CPRS ranges between about 30% and 45%. In the bond market, insurance and Investment funds are the top holders of CPRS sectors. Across institutional sectors the relative exposure to CPRS ranges between about 35% and 50%.

Table 9. Aggregate exposures of institutional sectors in CPRS sectors through equity holdings in 2018.

Holder Sector	Exposure to CPRS	Total (€ bn)
Investment funds (Non-MMF)	41.0%	1120
Non-financial corporations	30.5%	1031
Banks	36.4%	780
Non-EU other investors	41.2%	678
Other financial corporations	45.6%	645
Households	42.1%	558
Insurance corporations	40.9%	176
Pension funds	43.1%	85

Table 10. Aggregate exposures of institutional sectors in CPRS sectors through bond holdings in 2018.

Holder Sector	Exposure to CPRS	Total (€ bn)
Insurance corporations	47.7%	321
Investment funds (Non-MMF)	36.8%	295
Non-EU other investors	38.4%	137
Banks	40.5%	136
Money market funds (MMF)	44.2%	34
Households	36.5%	33
Pension funds	39.0%	23

3.3 Market coverage of the Taxonomy and Taxonomy-eligible market share

The EU sustainability taxonomy considers a subset of all economic activities. In order to illustrate the coverage of the EU Taxonomy, we define here an EU Taxonomy financial coverage as the total financial value of securities (equities or bonds) in the NACE codes that are considered by the EU Taxonomy. Notice that, in order to be Taxonomy-eligible, economic activities need not only to be in the list of NACE codes that are considered in the Taxonomy, but also to pass activity-specific thresholds and Do-No-Significant-Harm (DNSH) criteria. Therefore, the EU Taxonomy financial coverage represents an upper bound for the financial value of securities that may be associated with Taxonomy-eligible activities.

In this section, first we provide some results about the EU Taxonomy financial coverage. Then, we estimate the value of securities that could be associated with Taxonomy-eligible activities.

3.3.1 The coverage of the EU Taxonomy

Figures 8 and 9 show the amount of equity and bonds issued by firms belonging to NACE (sub)sectors that are covered by the EU Taxonomy.[37] The share of taxonomy-considered activities is heterogeneous across sectors. For example, the manufacturing sector is associated with the largest coverage, in levels, for both bonds and equities, corresponding to around €500 billion for each market. However, in relative terms, virtually 100% of the water and waste sector and almost the whole electricity and gas sector are covered. Moreover, comparing for example the electricity and gas sector (D) and the professional, scientific and technical advice sector (M), the former is smaller in size but its financial value covered by the taxonomy is larger than that of the latter for both bonds and equities. For instance, while the electricity and gas sector (D) only issued €292 billion of listed equity, the professional, scientific and technical advice sector (M) issued €1512 billion of listed equity. However, the equity issued by the electricity and gas sector (D) and is considered by the EU Taxonomy amounts to €235 billion and the equity issued the professional, scientific and technical advice sector (M) and is considered by the EU Taxonomy amounts to €65 billion. Both for listed equities and bonds, the sector with the highest EU Taxonomy consideration is the water supply, sewerage, waste management and remediation activities sector with a 99% coverage. Among the selected NACE sectors, the equity issued by NFCs and considered by the EU Taxonomy amounts to €958 billion, which corresponds to 13% of the total. Among the selected NACE sectors, the bond outstanding amount issued by NFCs and considered by the EU Taxonomy amounts to €228 billion, which corresponds to 17% of the total.

[37] The agriculture sector is covered by the Taxonomy but omitted from the figures as the financial value associated to this sector based on our dataset is negligible.

Figure 8. Issued equity breakdown by EU taxonomy coverage and by NACE sectors

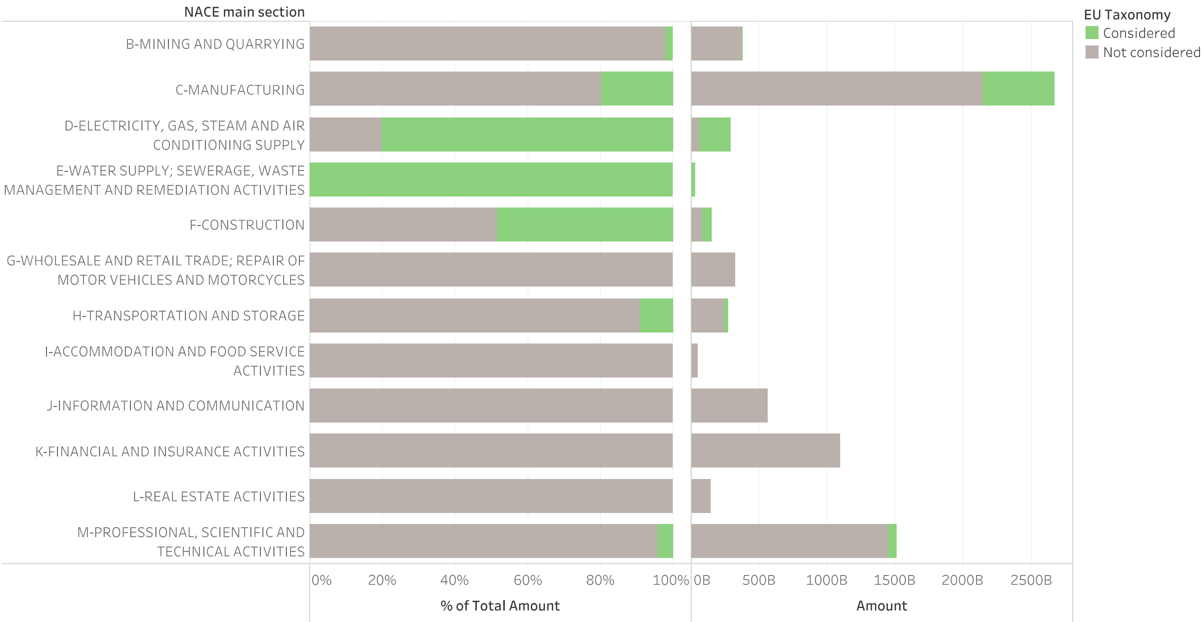
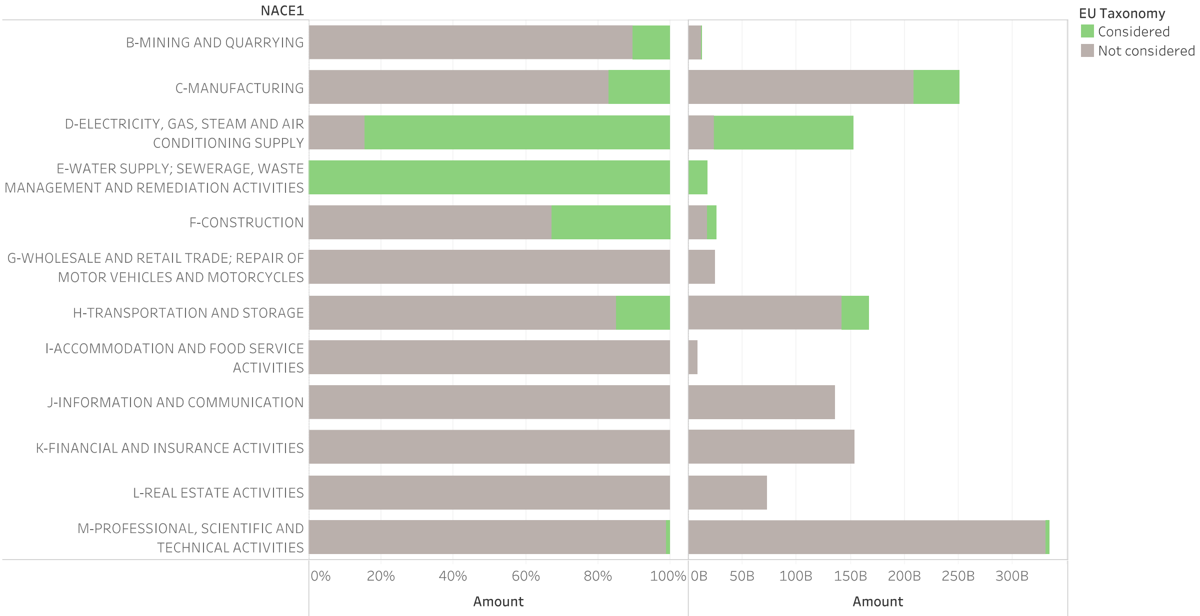


Figure 9. Issued bonds breakdown by EU taxonomy coverage and by NACE sectors



Figures 10 and 11 show the amount of equity and bonds issued by firms belonging to NACE (sub)sectors covered by the EU taxonomy, broken down by CPRS. The utility sector is not the largest in absolute terms, but is associated with the largest amount of financial value linked to taxonomy-covered activities, both for equities and for bonds. For instance, while the utility sector only issued €154 billion of bonds, the transportation sector issued €225 billion of bonds. However, the bonds in the utility sector considered by the EU Taxonomy amount to €147 billion, which corresponds to a 95% share, and the bonds in the transportation sector considered by the EU Taxonomy amount to €25 billion, which corresponds to a 11% share. For both listed equities and bonds, the sector with the highest EU Taxonomy consideration is the scientific R&D sector with a 100% coverage. Among the selected CPRS, the equity issued by NFCs and considered by the EU Taxonomy amounts to €628 billion, which corresponds to 19% of the total. Among the selected NACE sectors, the bond outstanding amount issued by NFCs and considered by the EU Taxonomy amounts to €202 billion, which corresponds to 32% of the total.

Figure 10. Issued equity breakdown by EU taxonomy coverage and by CPRS sectors

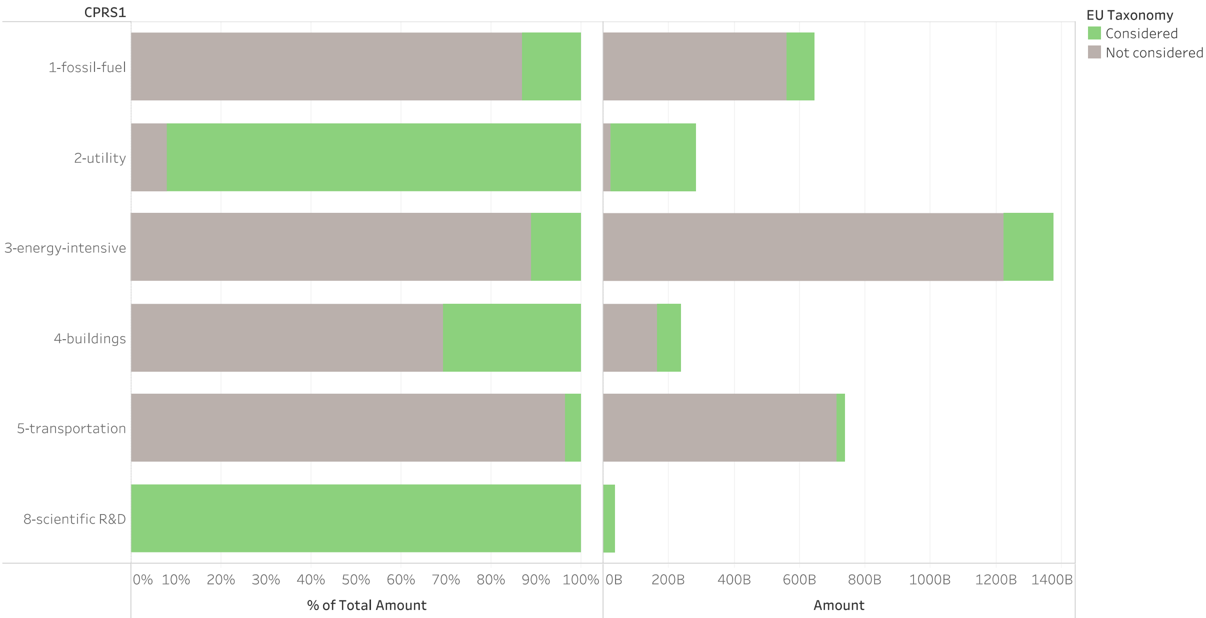
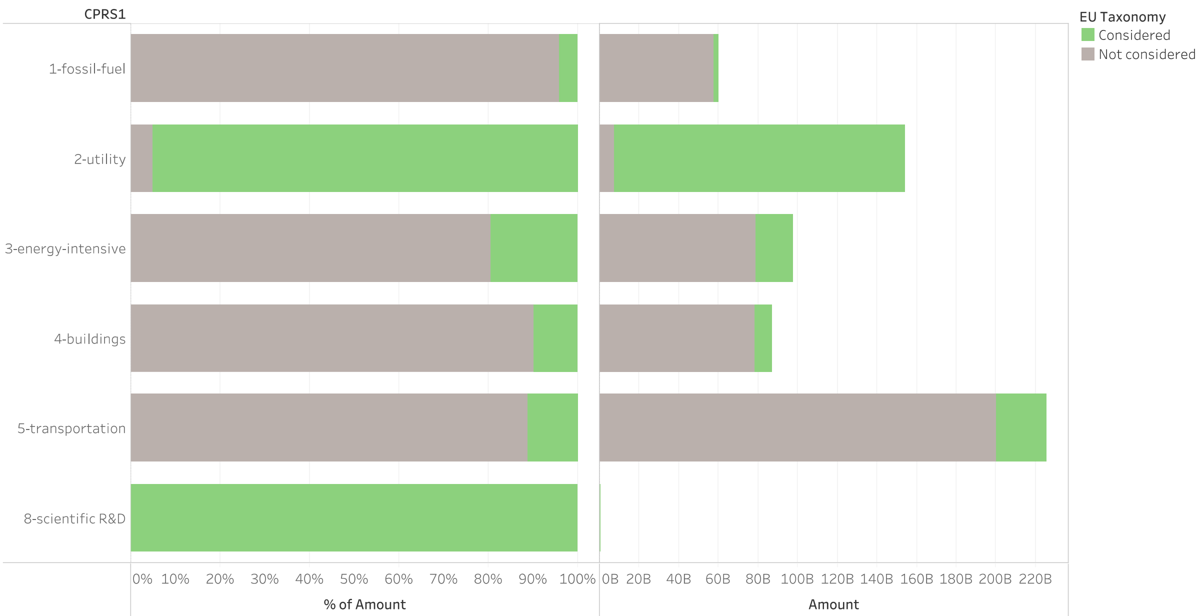


Figure 11. Issued bonds breakdown by EU taxonomy coverage and by CPRS sectors



Figures 12 and 13 breaks down equity and bond holdings of institutional sectors into holdings associated with EU Taxonomy considered and non-considered activities. In the case of equities, the share of holdings associated with Taxonomy-covered activities is rather stable over time and across institutional sectors, at around 15%. In the case of bonds holdings, on the contrary, the share of Taxonomy-covered holdings is heterogeneous across sectors and time, spanning from 0% to about 40%. In fact, the share of Taxonomy-covered holdings seems to have decreased over time for some sectors, notably insurers, pension funds, banks and investment funds. This is because the significant increase in the size of these sector's balance sheets over time has been associated with a comparatively larger investment into non-taxonomy-covered activities.

Figure 12. Equity holdings breakdown by EU taxonomy coverage and by institutional sectors

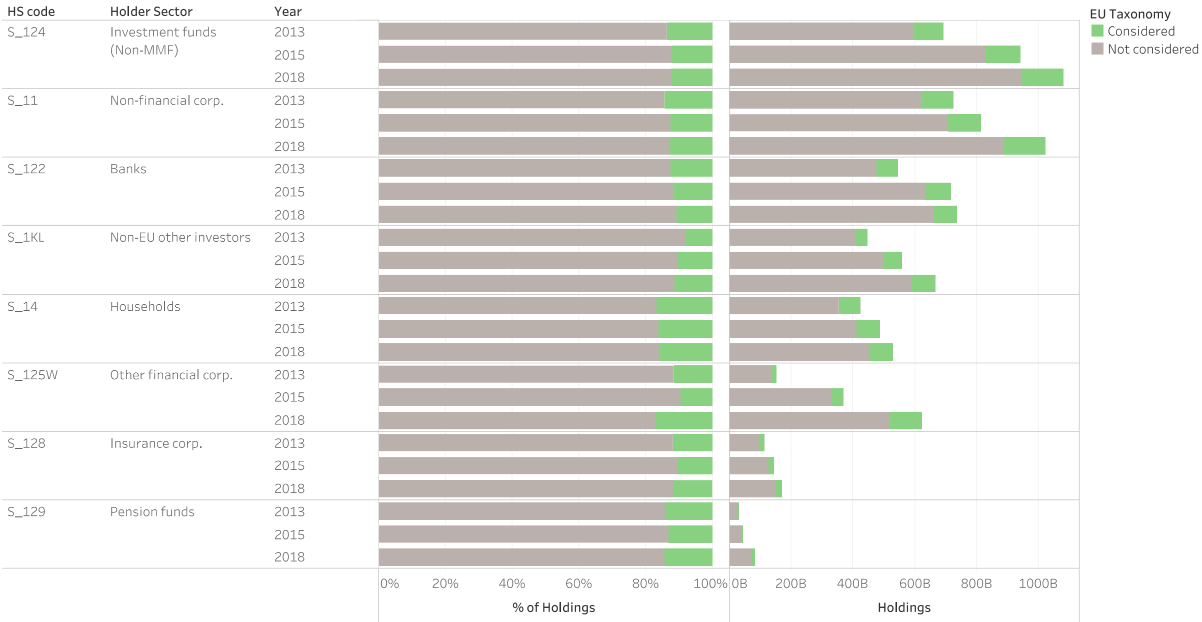
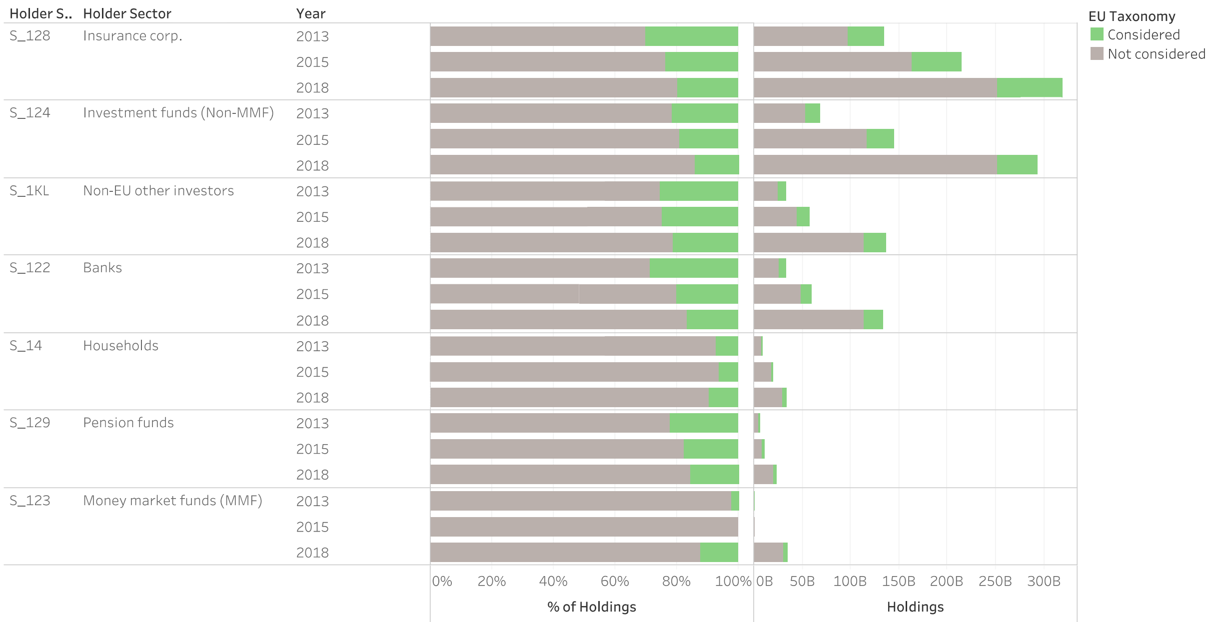


Figure 13. Bonds holdings breakdown by EU taxonomy coverage and by institutional sectors



3.3.2 Estimated investments in EU Taxonomy-eligible activities

Measuring the share of market investment which is currently funding environmentally sustainable economic activities is not trivial because firms typically engage in multiple activities (Thomae et al. 2018).[38] In particular, only some activities may be Taxonomy-eligible. In this section we attempt to estimate the share of financial investments currently financing EU Taxonomy-eligible activities, using a top-down approach and a bottom-up approach.

Top-down estimates

In this section we estimate the financial market share that could be EU Taxonomy-eligible at the aggregate level. As a proxy of the EU Taxonomy thresholds, we use the EU-ETS (Emission Trading System) benchmarks for the activities for which these are available, following the TEG approach. For those sectors for which no ETS-benchmarks are available, we refer to the criteria set out in the June 2019 version of the TEG Report. In particular:

- For the energy intensive sector, the ETS benchmark is defined as the average of the first decile of the installations, ranked by emission efficiency.[39] Assuming that installations' GHG emission efficiency is not correlated with size[40], we obtain an approximation for the sustainable financial market share as the 5% of the total market capitalization or outstanding bond amount in relevant sectors. This means that in each of the energy intensive sectors considered in the EU-ETS, on average, only 5% of the installations pass the EU-ETS benchmark.
- For the utility sector, we adopt different approaches depending on the specific subsector. For electricity generation, as well as transmission and distribution, we set the EU taxonomy threshold equal to the share of electricity production from renewable sources in Europe, i.e. 20.9%.[41] For activities related to water and waste (NACE 36, 37, and 38), that also belong to the utility CPRS, we set the taxonomy threshold to 5% in line with the ETS-based approach adopted for the energy intensive sector.[42] To maximize the coverage of our analysis, we have manually remapped the financial subsidiaries of European utility companies into the utility sector, in order to correctly allocate bonds issued by these financial subsidiaries to the utility sector – and not the finance sector, as originally indicated in the database.
- For the buildings sector, the three main subsectors are the following: construction of new buildings, renovation of older buildings and real estate. As for the construction of new buildings, we assume that 100% of these activities is Taxonomy-eligible. This assumption is in line with the EU Energy Performance of Buildings Directive (EPBD),

[38] Thomae Jakob, Dupré Stan and Hayne Michael, 2018, A Taxonomy of Climate Accounting Principles for Financial Portfolios, Sustainability 2018, 10, 328; doi:10.3390/su10020328

[39] https://www.emissions-euets.com/product-benchmarks

[41] We have computed the share of electricity production from renewable sources based on PACTA data. We are grateful to the EU PACTA project (No LIFE16-GIC FR 000061) for sharing their data.

[42] Notice that all activities that involve electricity production by means of renewable energy sources are fully Taxonomy-eligible (except for Hydropower). The same applies to railways (passenger and freight).

which requires all new buildings to be nearly zero-energy by the end of 2020.[43] The Taxonomy criteria for new buildings as published in the June 2019 report de facto imply that all new buildings are Taxonomy-eligible. For renovation activities, lacking information on the energy efficiency improvement that these activities bring about, we assume that a share of 5% is Taxonomy-eligible, in line with the ETS-based approach taken for the energy-intensive sector.[44] For real estate activities, the relevant Taxonomy criterion refers to the top performing 15% of the building stock as representative of the best level of energy and resource efficiency that can be achieved in a local context. Therefore, assuming that existing stock's efficiency is not correlated with size, for real estate activities we have set the threshold to 15%.

- For the transportation sector we have set the EU taxonomy threshold as follows: 100% for the manufacture of trains and bicycles, 100% for the rail passengers and freight transports, 50% for urban and suburban passenger land transport, and 0.6% for the automotive sector.[45] The latter corresponds to the share of electric vehicles sales in Europe in 2019. To maximize the coverage of our analysis, we have manually remapped the financial subsidiaries of the European automotive companies into the transport sector, thus correctly allocating the bonds they issue to the transport sector.

It should be noted that the estimates derived by applying the methodology described above are an upper bound for the actual financial value associated with Taxonomy-eligible activities, as some of the activities that are compliant with the thresholds may not be DNSH compliant.[46]

The estimated value of outstanding corporate bonds and estimated market capitalization associated with Taxonomy-eligible activities is shown in Figures 14 and 15. The estimated values of EU Taxonomy-eligible activities funded by bond issuance in 2018 (see Figure 14) are about the following: €40 billion for the utility sector, €1 billion for the energy-intensive sector, €17 billion for the buildings sector, and €10 billion for the transportation sector. The amount is negligible for the agriculture sector. Compared to the years 2013 and 2015, also shown in Figure 14, the outstanding bond amount estimated to finance taxonomy-eligible activities had increased steadily for the buildings sector, while it has somewhat decreased for the energy-intensive sector.

[43] The requirement of being nearly zero-energy applies to new public buildings as of 2018.
[44] A renovation is eligible when it meets either of the following criteria:
a) The renovation is compliant with energy performance standards set in the applicable building regulations for major renovations transposing the EPBD); or,
b) The renovation achieves energy savings411 of at least 30% in comparison to the baseline performance of the building before the renovation.

As for shares (see Figure 15), based on 2018 data, we estimate the market capitalization associated with Taxonomy-eligible activities to be as follows: around €55 billion for the utility sector, less than €10 billion for the energy-intensive sector, €45 billion for the buildings sector, and less than €5 billion for the transportation sector. The amount is negligible for the agriculture sector.

Figure 14. Share of outstanding bond amount estimated to finance EU Taxonomy-eligible activities

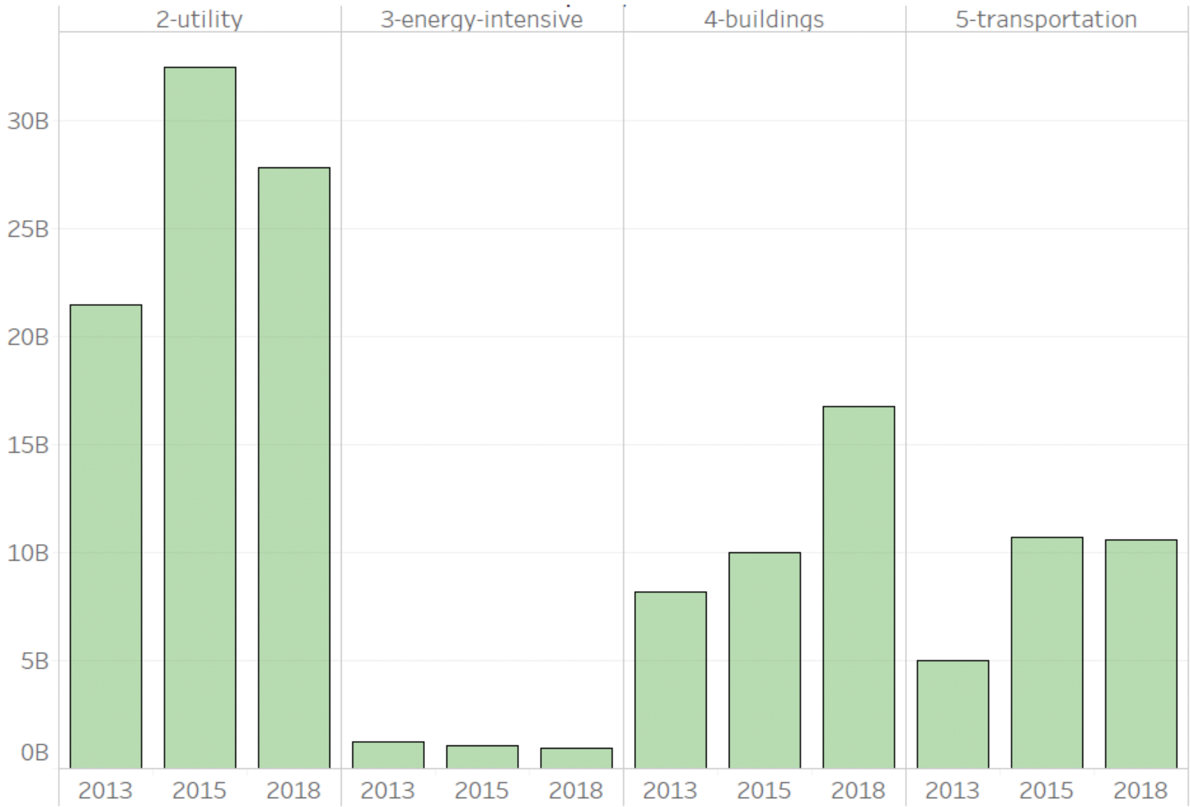


Figure 15. Share of market capitalization estimated to finance EU Taxonomy-eligible activities

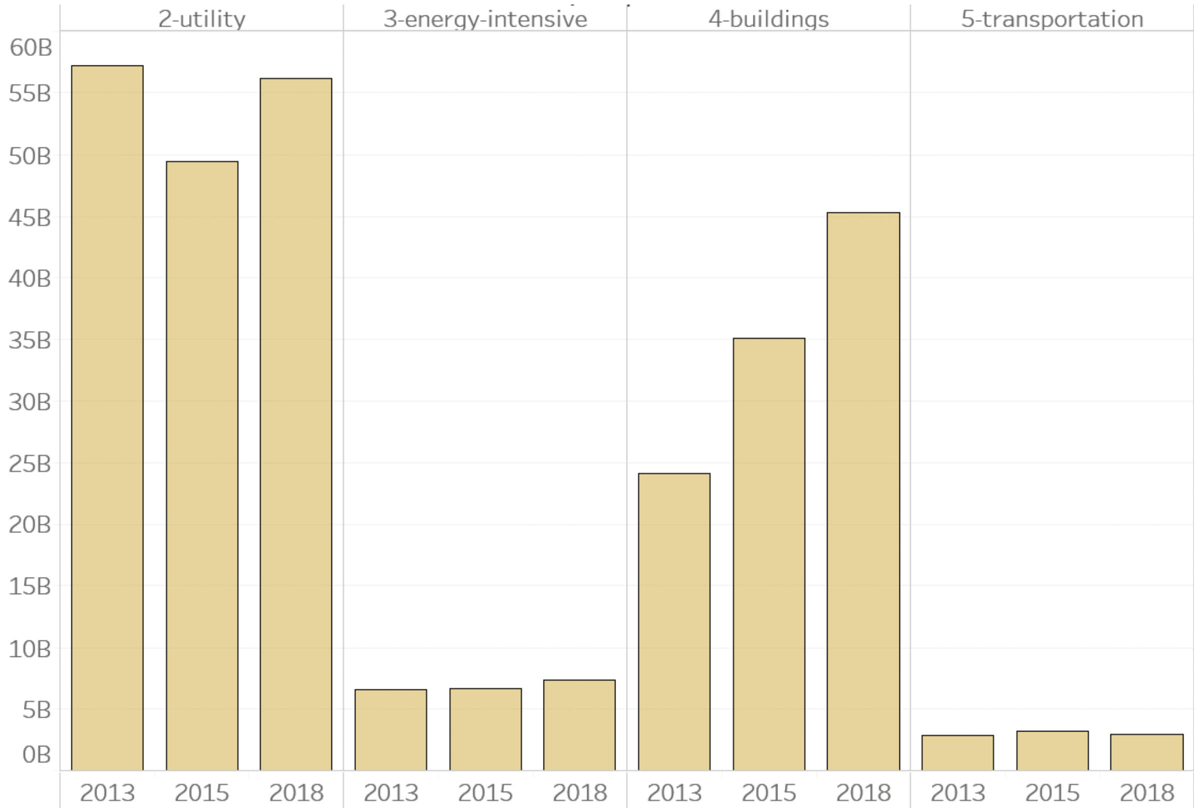


Table 11 summarizes the estimated values of outstanding bonds and market capitalization currently funding EU Taxonomy-eligible activities.

Table 11. Estimated financial investments into EU Taxonomy-eligible activities (based on 2018 data).

	Bonds in EU Taxonomy-eligible activities (estimated)	Market capitalization in EU Taxonomy-eligible activities (estimated)
CPRS Sector	**Amount (€ bn)**	**Amount (€ bn)**
Buildings	16.74	45.35
Energy Intensive	0.95	7.37
Transportation	10.59	2.85
Utility	27.82	56.17

In Table 12 we compare our estimates of bonds issued to finance EU Taxonomy-eligible activities with the information on green bonds from the Climate Bonds Initiative (CBI) and based on Eikon data. Notice that the CBI and Eikon use different definitions for economic activities, which we have mapped with each other and into CPRS sectors in a coherent manner. We find that about half of the EU Taxonomy-eligible activities in the utility sector is funded through green bonds. At the same time, less than 20% of the EU Taxonomy-eligible activities in the Transportation sector is funded through green bonds. These results suggest huge potential for green bonds as a tool to finance the low-carbon transition.

Table 12. Comparison of number and outstanding amount of green bonds issued by European NFCs based on CBI and Eikon, and estimates of outstanding bond amounts financing activities that are EU Taxonomy-eligible in 2018.

	Ggreen bonds, source: CBI[47]		Green bonds, source: Eikon		Bonds financing Taxonomy-eligible activities (estimated)
CPRS Sector	**CBI sectors**	**Amount (€ bn)**	**Eikon sectors**	**Amount (€ bn)**	**Amount (€ bn)**
Buildings	Property	9.44	Home Builders; Mortgage Banking; Building Products; Real Estate Investment Trust	3.54	16.74
Energy Intensive	NA	NA	Machinery; Electronics; Financial - Other; Conglomerate/Diversified Mfg; Consumer Products	0.89	0.95
Transportation	Transport	2.36	Railroads; Leasing (car); Transportation - Other	1.55	10.59
Utility	Energy; Waste; Water	37.89	Gas utility - local distribution; Utility - other	17.83	27.82

Bottom-up estimates

An alternative approach for the estimation of the financial market share associated with green activities is based on firm-level data. In particular, the share of value of the financial instruments issued by a given firm which is associated to sustainable activities may be estimated by comparing the shares of production capacity across activities (if units of output can be compared), or comparing the shares of revenues across activities (if the firm accounts them separately).

[47] The CBI country coverage is slightly different from the one used in this analysis. For details see the report "The Green Bond Market in Europe" available at https://www.climatebonds.net/resources/reports/green-bond-market-europe

In this section, estimates are based on FTSE Russell Green Revenues data.[48] The FTSE Russell Green Revenue Factor corresponds to the share of revenues of each company that can be associated to technologies which are considered green. Green technologies are classified as follows[49]:

- Energy generation and equipment: bio fuels, clean fossil fuels, geothermal, hydro, integrated energy generation and equipment, nuclear, ocean and tidal, solar, waste to energy, wind;
- Energy management: combined heat/power, controls, fuel cells, integrated energy management, logistics and support, power storage, smart grids;
- Energy efficiency: advanced materials, buildings and property, industrial processes, integrated energy efficiency, IT processes, lightning, video conferencing;
- Environmental infrastructure: carbon capture & storage, desalination, flood control & land erosion, integrated environmental infrastructure, logistics & support, pollution management, recyclable products, recycling services, waste management, water management;
- Environmental resources: agriculture, aquaculture, integrated environmental resources, mining, minerals and metals, source water, sustainable forestry;
- Modal shift: aviation, integrated modal shift, railways, road vehicles, shipping;
- Operational shift: finance/investment, integrated operational shift, retail/wholesale, property.

For instance, for a company active in the agricultural sector, relevant green activities are defined as those "providing goods, products and services that are specifically able to enhance the viability, yield, scope and sustainability of agricultural output in accordance with domestic or internationally recognized standards where applicable."

The FTSE Russell green technologies list does not consider exclusion principles such as the "do no significant harm" (DNSH) foreseen in the EU Sustainability Taxonomy. This means that the FTSE Russell definition of "green" could be looser that the Taxonomy definition. At the same time, FTSE Russell has wider definition of "green" compared to the one of the Taxonomy as is, which at this stage only focusses on climate change. Hence, estimates based on FTSE Russell data could be better suited to capture the broader coverage that the Taxonomy will have once screening criteria will be developed for the other environmental objectives.

We take the 'green' revenue share of a company as a proxy for the use that this company does of the funds raised on the market. In other words, it is assumed that firms invest in green projects proportionally to the turnover

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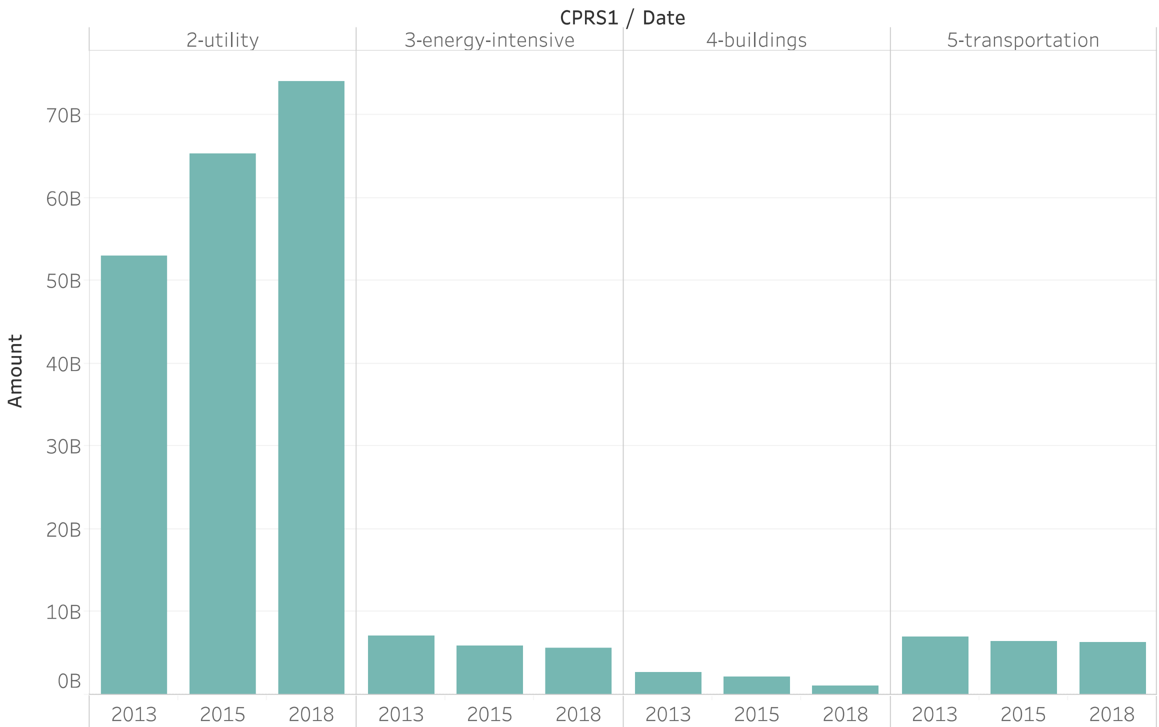
[48] As a robustness check, for the share of production capacity, we use data from the PACTA project (for firms in the CPRS sectors fossil-fuel, utility and transport|automotive).

[49] A more comprehensive document illustrating each sector and subsector can be found at https://research.ftserussell.com/products/downloads/FTSE_Green_Revenues_Classification_System.pdf. We use a version of FTSE Russell Green Revenues data which excludes nuclear from green.

share currently associated to their green activities. The estimated amounts, shown in Figure 15, are larger than those estimated under the Taxonomy criteria for the utilities and energy-intensive sectors. This may be due to a looser definition of green by FTSE Russell compared to the EU Taxonomy. In this case, these former estimates could be interpreted as a counterfactual scenario, characterized by less stringent Taxonomy criteria. The estimates based on FTSE Russell data are comparable to those derived with a top-down approach for the transport sector, while they are lower for the buildings sector.

Figure 16. Outstanding bond amount estimated to finance green activities based on Green Revenues data by FTSE Russell.



4 Best outcome scenario

The assessment of the implications of the Taxonomy for EU financial markets builds on the available estimates of additional investment needs, on the one hand, and on the estimates of market funding currently financing environmentally sustainable activities, on the other hand. These have been provided in the first and second sections, respectively. To reflect different levels of uptake of a Taxonomy providing increased transparency for financial markets, various best outcome scenarios are considered. These correspond to achieving the EU2030 targets, under the various EUCO27 – EUCO+40 scenarios described in Section 2. In other words, this section presents estimates of what the impact would be for financial markets under each of these scenarios, assuming that the Taxonomy would contribute to achieve the targets. These estimates correspond to an upper bound for the impact of the Taxonomy, which coincides with the best outcome, where climate and energy targets are met, under the various scenarios.

The sustainable investment gap described in Section 2 can be regarded as a form of additional capital expenditures (CAPEX) which firms could finance in various ways, including by raising money on the market. Although the relation between capital expenditures and financial investments is not straightforward, and the existing literature does not provide standard ways to relate them, this section provides insights on how the investment gap could be financed by various financial instruments.

CAPEX have an impact on firms' future profitability and can be a driver of increased market value of firms. CAPEX can be funded by firms with the issuance of new equity or via retained earnings, for example. However, no aggregate data are available to obtain a precise estimate of the CAPEX share that is funded via these sources. Therefore, the following calculations only consider the issuance of bonds and the granting of loans as funding sources for new sustainable investments. Hence, the estimates can be interpreted as an upper bound for the impact on the fixed-income market and bank loan exposure, as part of the estimated increase outstanding amounts will in fact be replaced by equity or internally generated means. A second assumption relates to the relative importance of bonds and loans as funding sources, by sector. This is assumed to be constant over time and equal to the observed funding mix in 2018 (in the following, "assumption of constant funding mix"). This appears as a reasonable assumption, as the funding mix does tend to remain broadly stable over time, though exhibiting striking differences across sectors.

The details of the estimation and the interpretation of the results shown in Table 17 are provided below.

4.1 Investment gap vs Ref2016

For each sector and scenario, the investment gap vs Ref2016 (in billions of euro) represents the difference in investment needs in each of the EUCO scenarios with respect to the Ref2016 scenario. As explained in the previous section, the Ref2016 is similar in spirit to the status quo, i.e. a business-as-usual scenario. The figures are based on those shown in Table a.2. Interestingly, for the utility sector the investment gap turns negative under the most stringent scenarios. At the same time, the investment gap in buildings represents the higher share of the investment gap in all scenarios compared to other sectors, and close to 90% under EUCO+40.

For each sector and scenario, the investment gap vs Ref2016 (percentage) represents the relative increase of investment needs with respect to the Ref2016 scenario. In the EUCO30 scenario, the values span from 4.4% in the transport sector to 88% in the buildings sector. Larger values of this indicator imply that the gap represents a larger share of the average annual investment level in the reference scenario.

4.2 Investment gap compared to outstanding bond and loan amounts

In a given sector, the ratio "gap / total bonds and loans" is defined as the investment gap divided by the total value of outstanding of bonds issued by firms in the sector and loans granted to firms in the sector. This number represents the percentage increase in bond issuance and bank loans that would be needed in order to finance the investment gap.

In the EUCO30, the values of this ratio across sectors read 2.8%, 0.54%, 5.3% and 7.0%, for the utility, energy-intensive, transport and buildings sectors, respectively. Under the assumption of constant funding mix, these percentages correspond to the projected growth rates for the outstanding bond and loan amounts, associated to the respective sectors. Based on these growth rates, values in billions of euro are provided below.

4.3 Investment gap funded by bonds

We define as "share of bonds" in a given sector the amount of bonds divided by the sum of bonds and loans invested in the sector. The quantity "investment gap funded by bonds" is defined as the product of the investment gap and the share of bonds, and it is measured in billion Euros.

This quantity can be interpreted as the portion of the investment gap that would be financed through the issuance of new bonds under the assumption of empirical funding mix.

In the EUCO30 scenario, the values we obtain across sectors read €4.7, €0.59, €12 and €6.1 billion, for the sectors utility, energy-intensive, transport and buildings, respectively.

Notice also that not all of the additional bonds, even if they would be targeted at financing sustainable activities, would necessarily be issued under the EU Green Bond standard. Hence, the values of the investment gap funded by bonds represents an upper bound for the estimated impact of the Taxonomy on the issuance of Green Bonds under the EUCO scenarios.

Overall, in the EUCO30 scenario, the total amount of additional bonds needed to fill the investment gap across sectors sum up to €23 billion, ranging up to €42 billion in the EUCO+40 scenario.

4.4 Investment gap funded by loans

We define as "share of loans" in a given sector the amount of loans divided by the sum of bonds and loans invested in the sector. The quantity "investment gap funded by loans" is defined as the product of the investment gap and the share of loans, and it is measured in billion Euros.

This quantity can be interpreted as the portion of the investment gap that would be financed through the granting of new loans under the assumption of empirical funding mix.

In the EUCO30 scenario, the values we obtain across sectors read €6.3, €3.4, €19 and €126 billion, for the sectors utility, energy-intensive, transport and buildings, respectively.

In the case of the buildings sector, the value tends to be significantly larger than in the other sectors across scenarios. This result can be explained by the fact that much of the investment gap described by the EUCO scenarios refers to energy efficiency improvements in residential and commercial buildings belonging to households and small firms, who typically do not issue bonds but finance their investments through loans.[50]

Loans would play a key role in the transition of the transport sector as well. Indeed, part of the investments needed for this sector under the EUCO30 scenario refer, on the one hand, to improvements in the energy efficiency of vehicles, as well as the electrification of the vehicle fleet. These investments pertain to the CAPEX of automotive companies, many of which issue corporate bonds. On the other hand, another part of the investment gap relates to infrastructures and policies to facilitate adoption of electric vehicles, which pertain to local authorities, households and small firms, which do not issue bonds and which are finance through loans.

Overall, in EUCO30 scenario, the total amount of loans across sectors sum up to €155 billion, ranging up to €586 billion in the EUCO+40 scenario.

4.5 Overall financial impact

The financial impact assessment presented in this section assumes that the EU Taxonomy would help redirecting financial resources towards sustainable economic activities and contribute to fill the investment gap in the relevant sectors. In the best case, the EU Taxonomy would help reaching the targets.

The estimated impact on financial markets of filling the investment gap varies across sectors and scenarios. In general, however, the increased financial investments towards relevant sectors appear to be within reach, at least under the least stringent scenarios (EUCO27 and EUCO30), compared to the current size of the corporate bond market and outstanding loans to NFCs. Even in the most stringent scenario (EUCO+40), estimates show that the (green) bond and loan issuance would increase by around

[50] The focus is on non-financial corporations, hence "green mortgages" are excluded from the calculations.

4.9% in the energy-intensive sector and by 6.0% in the transport sector. This also means that filling the gap is compatible with a modest increase of the leverage of relevant sectors and with a reasonable increase of the exposure of institutional investors, via bond holdings and loans, to firms in the relevant sectors.

At the same time, by comparing Figure 14 and Table 13 and focusing on the bond market, the increased annual financing needs under all scenarios are close to the outstanding bond amounts currently financing sustainable activities in the energy-intensive, buildings and transportation sectors. In particular, it is estimated that less than €1 billion additional bond financing would be needed annually in the energy intensive sector under the EUCO27-30 scenarios, while the outstanding bond amount currently financing EU Taxonomy-eligible activities in this sector is also estimated at around €1 billion. This figure increases to around €10-12 billion for the transport sector, where bonds already financing Taxonomy-eligible activities are estimated to be also around €10 billion. For the utilities sector, where around €30 billion bonds are estimated financing Taxonomy-eligible activities, increased bond financing needs amount to €6 billion in the EUCO27 scenario.

Table 13. Investment Gap and EU Financial Markets. Estimated breakdown of investment gap financing across CPRS sectors and EUCO scenarios

Sector (CPRS)		Scenarios				
		EUCO27	**EUCO30**	**EUCO+33**	**EUCO+35**	**EUCO+40**
Utility	Investment gap vs Ref2016 (€ bn)	14	11	7	1	-5
	Investment gap vs Ref2016 (%)	21	16	10	1.5	-7.5
	Ratio gap/total loans and bonds (%)	3.5	2.8	1.8	0.3	-1.3
	Gap funded by bonds (€ bn)	6.0	4.7	3.0	0.4	-2.1
	Gap funded by loans (€ bn)	8.0	6.3	4.0	0.6	-2.9
Energy Intensive	Investment gap vs Ref2016 (€ bn)	2	4	9	14	36
	Investment gap vs Ref2016 (%)	13	27	60	93	240
	Ratio gap/total loans and bonds (%)	0.27	0.54	1.2	1.9	4.9
	Gap funded by bonds (€ bn)	0.29	0.59	1.32	2.06	5.3
	Gap funded by loans (€ bn)	1.7	3.4	7.7	11.9	31
Transport	Investment gap vs Ref2016 (€ bn)	26	31	24	28	35
	Investment gap vs Ref2016 (%)	3.7	4.4	3.4	4.0	5.0
	Ratio gap/total loans and bonds (%)	4.4	5.3	4.1	4.8	6.0
	Gap funded by bonds (€ bn)	10	12	9	11	13
	Gap funded by loans (€ bn) *	16	19	15	17	22
Buildings	Investment gap vs Ref2016 (€ bn)	48	132	255	344	562
	Investment gap vs Ref2016 (%)	32	88	170	229	375
	Ratio gap/total loans and bonds (%)	2	7	13	17	28
	Gap funded by bonds (€ bn)	2.2	6.1	12	16	26
	Gap funded by loans (€ bn)	46	126	243	328	536
Total investment gap (€ bn)		**90**	**178**	**295**	**387**	**628**

* The amount of loans granted by euro area banks to the transportation and storage sector (H) and information and communication sector (J) are only available at an aggregate level. Thus, the denominator in the ratio gap/bank loans for the transport sector refers to the total amount of the loans granted to the two sectors combined (H+J).

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