



A technical case study - modelling analysis on selected EU policy levers aiming to promote clean energy finance

*Technical Study on the Macroeconomics of
Energy and Climate Policies*

Prepared by

Carmen van den Berg, Trinomics
Unnada Chewpreecha, Cambridge Econometrics
Lisa Eichler, Trinomics
Kostas Fragkiadakis, E3-Modelling
Richard Lewney, Cambridge Econometrics
Leonidas Paroussos, E3-Modelling
Hector Pollitt, Cambridge Econometrics
Koen Rademaekers, Trinomics
Yamina Saheb, Trinomics

Contact:

Richard Lewney
rl@camecon.com

This study was ordered and paid for by the European Commission, Directorate-General for Energy, Contract no. ENER/A4/2015-436/SER/S12.716128. The information and views set out in this study are those of the author(s) and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

© European Union, January 2018
Reproduction is authorised provided the source is acknowledged.
More information on the European Union is available at <http://europa.eu>.

Table of Contents

Executive Summary	4
Part I Introduction.....	7
Part II Setting the scene: introducing the policy options.....	8
Policy measure 1: The ambition of earmarking 40% of EFSI 2.0 projects under the 'infrastructure and innovation window' for clean energy transition projects	8
Description of the policy lever.....	8
Analysis of current EFSI project database	9
Feasibility of the policy measure	11
Relevance to influencing factors	12
Anticipated impacts on targeted financing sources	12
Estimated scale of overall impact on influencing the clean energy finance landscape	13
Policy measure 2: Testing the implications of the three pillars of the Smart Finance for Smart Buildings (SFSB) initiative	14
Description of the policy lever.....	14
Feasibility of the policy measure	14
Relevance to influencing factors	15
Expected effects on targeted clean energy projects	15
Estimated scale of overall impact on influencing the clean energy finance landscape	16
Part III Modelling approach and results	18
Earmarking 40% of EFSI 2.0 projects under the 'infrastructure and innovation window' towards clean energy transition projects.....	18
Scale and timing	18
Modelling approach and results.....	18
Smart Finance for Smart Buildings (SFSB)	23
Modelling approach and results.....	23
Part IV Conclusions	27
Channels of impact	27
EFSI 2.0 funding for RES	27
EFSI 2.0 and SFSB funding for energy efficiency	28

Executive Summary

This report examines policies that have recently been put into operation in Europe to influence the European clean energy finance landscape, namely:

- earmarking 40% of EFSI 2.0 projects under the 'infrastructure and innovation window' for clean energy transition projects
- the Smart Finance for Smart Buildings initiative

The analysis is undertaken in two steps:

(1) a brief review of the policies to establish their scale the logic by which they are intended to stimulate clean energy investment, and the expected effects

(2) representation of the policy in the E3ME and GEM-E3-FIT whole-economy macro-sectoral models and interpretation of the results.

EFSI 2.0

EFSI 2.0 is supporting an expected total private and public investment of at least €500bn (up from €315bn in the initial phase of EFSI) over the period to 2020. The expected increase in funding under EFSI 2.0 is therefore €185bn. On the basis of the projects already funded under EFSI, some €52bn of the €185bn would be earmarked for clean energy projects finance. Of this, investment in *renewable energy infrastructure* would account for 42% (€21.8bn) and the rest would finance investment in various *energy efficiency and other decarbonising improvements*.

The impact on *investment in renewables* (and then the impacts on energy use, emissions and the wider economy) of this additional finance has been assessed in the E3ME and GEM-E3-FIT models. Both include a detailed treatment of power generation, distinguishing different technologies and hence allowing an explicit representation of the policy intended to stimulate greater investment in renewables. The model simulations work by changing the cost of capital for selected renewables technologies and observing the impact on the scale and pattern of investment.

The modelling assumes that the same addition to power generation capacity would have occurred with and without EFSI 2.0, because the overall scale of capacity that is built in power generation is determined by projected demand, and that projected demand is not much affected by the policy. Hence, the EFSI 2.0-funded investment involves a substitution of investment in near-commercial renewable technology projects for other electricity generation investment. The key assumptions for the impact of EFSI 2.0 are that it brings about a 2 pp cut in the cost of capital for wind, including onshore wind, and solar PV, and that this is sufficient to make projects commercially viable in comparison with fossil fuel alternatives, such as combined-cycle gas turbine (CCGT) power stations.

Both models predict a substantial impact on investment in wind projects at the expense of CCGT investment. They also predict an increase in investment in solar photovoltaic (solar PV) generation capacity, but this effect is considerably larger in E3ME than in GEM-E3-FIT. Consequently, in E3ME the total additional investment in renewables is somewhat larger than the €21.8bn envisaged on the basis of projects already funded under EFSI, whereas in GEM-E3-FIT it is slightly less.

The two models give different results because of their different treatment of the take-up of new technologies in power generation. GEM-E3-FIT already has a stronger shift

than E3ME out of fossil fuels and into renewables on the basis of *existing* incentives, before EFSI 2.0 is considered. The smaller shift in E3ME is due to its assumption of slower take-up of technologies with a small market share, even if they appear more attractive on the basis of relative costs, reflecting uncertainty about whether the expected profitability will be realised. EFSI 2.0 triggers in E3ME some of the solar PV investment that GEM-E3-FIT predicts would come about under existing incentives.

Hence, the modelling concludes that EFSI 2.0 will promote greater investment in wind and solar PV power generation capacity. The scale of impact (i.e. the extent to which the investment proves to be additional to what would have happened otherwise) depends on the assessment of the extent to which investment is currently held back not just by the expected return on investment but also uncertainty over that return. The impact is larger in the case of the model (E3ME) that puts greater weight on that uncertainty. The impact on overall GDP (an increase of some 0.05%) reflects the scale of the investment: €15-20bn (net) over 8 years compared with total EU28 investment of a little under €3,000bn in 2016. The models differ in their assessment of the impact in the period after 2020: in E3ME the GDP increase is sustained, whereas in GEM-E3-FIT the higher unit cost of electricity is sufficient to reduce GDP slightly. At the sectoral level there is an increase in production and employment in wind and PV manufacturing.

Existing investments funded under *energy efficiency and other decarbonising improvements* (hereafter, 'EEO') are quite varied in nature. About half of the EEO funding for existing projects is going into various kinds of energy and related infrastructure: this includes upgrading, replacement and extension of gas and electricity distribution networks including some interconnectors. About 10% of existing EEO funding is going into transport, a mix of funding for R&D into greater energy efficiency / reduced emissions for vehicles and funding to support the purchase of public transport vehicles running on alternative fuels. The remaining 40% of EEO funding is largely in projects to promote energy efficiency in buildings (including a substantial part for smart meters).

We have focused the modelling of the EEO element of EFSI 2.0 on the part that brings about investment in greater energy efficiency in buildings. It is assumed that the same proportion of EEO funding as in the initial phase of EFSI is taken up in loans for investment in energy efficiency, amounting to some €12.1bn which we divide equally between residential and commercial buildings in service sectors. The modelling estimates the impact of this additional investment on final energy use in buildings and the consequent wider impacts (for example, reduced electricity demand and hence power generation). EU energy use across all sectors in 2020 and 2025 is reduced by about 0.5-0.7%% compared with the no-EFSI case (and by more in households than in commercial buildings).

Taking the two kinds of EFSI 2.0 impacts together (the additional RES investment *and* the additional energy efficiency investment), the energy efficiency projects reduce somewhat the need for investment in renewable power generation, while the boost to investment and incomes of both the RES investment and the energy efficiency investment raises economic activity and curbs a little the reduction in final energy demand arising from greater energy efficiency.

Smart Finance for Smart Buildings

The Smart Finance for Smart Buildings (SFSB) initiative is a non-legislative proposal included in the Clean Energy for all Europeans Package. It aims at unlocking private

financing and scaling-up energy renovation projects by: supporting the better use of public funds via new and/or up-scaled financial instruments; helping project developers bringing good project idea to maturity; and making the energy efficiency market more trusted and investible for investors. It is intended to operate through a number of channels ('pillars'):

- Pillar 1: More effective use of public funding to provide loan guarantees for energy renovation projects
- Pillar 2: Aggregation and assistance for project developments, bundling small projects together to form larger packages
- Pillar 3: De-risking through better information, reducing the perceived risk through the availability of certified information about the return on investment

The approach has been to model the impact of achieving the Commission's ambition for the scale of additional investment in energy efficiency in buildings brought about by the initiative, namely an additional €10bn (of both public and private funds) by 2020.

The impact is to curb energy use in buildings across all fuels, producing a reduction in EU economy-wide energy use (including the use of energy in power generation, which is reduced in response to lower final demand for electricity) by about 0.5% by 2025. The GDP impacts reflect the scale of the assumed boost to investment and the subsequent net income effects arising from lower energy expenditures versus the financing cost associated with the investment; GDP is about 0.06% higher by 2020 and 0.07% in 2025.

Part I Introduction

This report examines particular policies that have recently been put into operation in Europe to influence the European clean energy finance landscape, namely:

- earmarking 40% of EFSI 2.0 projects under the 'infrastructure and innovation window' for clean energy transition projects
- the Smart Finance for Smart Buildings initiative

The analysis seeks to apply what has been learned in the course of the wider project 'Study on the Macroeconomics of Energy and Climate Policies' (Contract no. ENERIA41201S-436/SER/S12.716128) with regard to how better to reflect in macroeconomic modelling the issues relating to the role of finance for supporting clean energy investment, including in particular the findings of *Mapping of the current EU clean energy landscape*¹ under Work Package 3.

The analysis is undertaken in two steps:

(1) a brief analysis of the policies to establish their scale, the logic by which they are intended to stimulate clean energy investment, and the expected effects

(2) representation of the policy in the E3ME, and GEM-E3-FIT whole-economy macro-sectoral models, and interpretation of the results.

Step (1) is described in Part II of this report, and step (2) is described in Part III.

Finally, conclusions about the modelling exercise are discussed in Part IV.

¹ Available at <https://ec.europa.eu/energy/en/studies/mapping-current-eu-clean-energy-finance-landscape>.

Part II Setting the scene: introducing the policy options

This chapter introduces the two policy levers covered in this report and briefly analyses them with respect to their suitability for this case study.

Policy measure 1: The ambition of earmarking 40% of EFSI 2.0 projects under the 'infrastructure and innovation window' for clean energy transition projects

Description of the policy lever

EFSI is an initiative launched jointly by the EIB Group - European Investment Bank (EIB) and European Investment Fund (EIF) – and the European Commission to help overcome the current investment gap in the EU by mobilising private financing for strategic investments. EFSI is one of the three pillars of the 'Investment Plan for Europe' that aims to revive investment in strategic projects around Europe to ensure that money reaches the real economy. With EFSI support, the EIB Group will provide funding for economically viable projects where it adds value, including projects with a higher risk profile than ordinary EIB activities.

In its June 2016 communication² 'Europe investing again –Taking stock of the Investment Plan for Europe and next steps', the EC envisaged an 'extension of the duration of the European Fund for Strategic Investments (EFSI) beyond its initial three-year period, the scaling-up of the Infrastructure and Innovation Window as well as the SME window within the existing framework and the enhancement of the European Investment Advisory Hub (EIAH)'. In September 2017, the European Parliament and Member States agreed on the extension and reinforcement of EFSI ('EFSI 2.0') including increasing the EU guarantee from €16bn to 26bn and EIB capital from €5bn to €7.5bn, with an **expected total private and public investment of at least €500bn** (up from €315bn). EFSI was initially established for a period of three years (2015-2018), and is now extended until 31 December 2020.

EFSI 2.0 focuses even more on sustainable investments in all sectors to contribute to meeting COP21 objectives and to help to deliver on the transition to a resource efficient, circular and zero-carbon economy. To this end, **at least 40% of EFSI projects under the infrastructure and innovation window should contribute to climate action in line with the COP21 objectives**. In addition, the European Investment Advisory Hub will offer further support to the preparation of climate-friendly projects.

EFSI 2.0 also further reinforces the selection criteria for funding eligibility under EFSI. For example, only projects that would not have happened at the same time or to the same extent without EFSI (additionality concept) should be eligible. Another important selection criterion is that projects under EFSI need to address sub-optimal investment situations and market gaps. Also, given their importance for the European Single Market, cross-border infrastructure projects (incl. services) have been specifically identified as providing additionality. Given its excellent performance with SMEs to date, EFSI 2.0 should also allocate an even larger share of financing for SMEs. Finally, an important objective of EFSI 2.0 is also to extend the geographical coverage and to reinforce take-up in less developed regions.

² COM(2016) 359 final.

An overview of the current project pipeline of the EFSI 'Infrastructure and Innovation Window' can be found here: <http://www.eib.org/efsi/efsi-projects/index.htm>. This pipeline has been used as a basis for our analysis in the following sections, with a cut-off date of end-2016.

These EFSI projects are those approved for the 'Infrastructure and Innovation Window', which is the one relevant for the present analysis. The list of agreements signed with intermediaries under the 'SME Window', on the other hand, is available at: http://www.eif.org/what_we_do/efsi/index.htm.

Snapshot of EFSI developments in 2017

In 2017, 25 energy-related projects with a total EFSI funding contribution of just over €2bn were approved. The total EFSI-related finance amounts to approximately €6.5bn. These figures are a conservative estimate because some of the 25 projects do not disclose financial information.

About 32% of the 2017 EFSI energy-relevant finance volume was spent on energy efficiency improvements in the buildings sector (both residential housing and public buildings), followed by investments in energy infrastructure (26%), onshore wind (5%), and energy efficiency improvements in industry (2%). The remaining 35% of the 2017 EFSI finance was approved for investment funds investing in either RES or energy efficiency projects to support the energy transition.

Analysis of current EFSI project database

We have carried out an analysis of the projects currently already approved under the EFSI's 'Infrastructure and Innovation Window' (175 projects total until 31-12-2016).³⁴ The analysis was based on a document provided by DG ENER providing additional more detailed information complementing the online EFSI database regarding the relevance of each project to clean energy sub-sectors.

This first selection resulted in a list of 62 clean energy relevant projects out of the total of 175 EFSI projects in the database. We have used the assumptions provided by DG ENER regarding the relative percentage of the total EFSI finance earmarked for the clean energy relevant part of the project (categorised as 100% energy objective, ≥50% energy objective, <50% energy objective). We have complemented this list with projects that we consider represent energy efficiency measures but are listed under EFSI's 'Transport' category. These amount to a total of 7 additional projects for the same time period. As a next step, we then categorised the investments made in these projects into ten clean energy subsectors.⁵

Based on this analysis, Table II.1 summarises the EFSI-related finance going into clean energy projects. According to our calculations, a total of €37.5bn (out of €163.9bn total overall EFSI-related funding⁶ including both EFSI and leveraged

³ See <http://www.eib.org/efsi/efsi-projects/index.htm> :

⁴ Project information has been extracted from the publicly available database: <http://www.eib.org/efsi/efsi-projects/index.htm>. The total of 175 projects in the database until 31-12-2016 consists of: 121 signed, 54 approved projects.

⁵ There are a number of projects in which the investments fall under multiple categories. We therefore used the following assumptions: Where projects are stated as fostering both efficiency and renewable investments, without further clarification, we assumed a 50/50 ratio of the investment. The subcategory for the efficiency part was then assigned based on the sector category as indicated in the EFSI database.

⁶ European Fund for Strategic Investments in 2016:

additional public and private finance across all sectors), i.e. just around 23% of all approved projects, was (as of 31-12-2016) already being invested in clean energy (RES and EE) projects. These €37.5bn are made up of an EFSI contribution amounting to €8.6bn and additionally leveraged finance of €28.9bn from other public and private financing sources.

Table II.1 Overview of finance for clean energy projects, compared to all EFSI projects (in €m)

	EFSI finance (only)	Additional EFSI related (mobilised) finance (from public and private sources)	Total EFSI related finance
Clean energy projects	8576	28914*	37489*
All projects	30200	133700	163900
% clean energy	28.4%	21.6%*	22.9%*

Based on the analysis of the current EFSI database (see Table II.2), the following clean energy sectors receive by far the most funding from EFSI:

- RES – mixed (this category includes mainly investment funds that in turn invest in various RES technologies, primarily focused on solar PV, onshore/offshore wind, biomass and hydro)
- EE – energy infrastructure (energy efficiency investments in grid/transmission infrastructure and/or within utilities/power companies)
- RES – offshore wind (direct EFSI finance for a specific offshore wind project)
- Smart meters.

The following table and figures present the results of the project database analysis by clean energy category of investment.

Table II.2 Split of current EFSI funding per clean energy sector (in €m)

	Energy efficiency							Renewable Energy				Total clean energy
	Energy infra-structure / supply	Mixed / other infra-structure	Industry	Commercial buildings	Residential housing	Transport	Smart meters	Mixed	Onshore wind	Offshore wind	Biomass	
EFSI finance ONLY	2181	154	96	252	618	883	1941	798	80	1293	280	8576
Additional EFSI related (mobilised) finance	4826	4307	121	897	312	1231	3900	7536	73	5430	282	28914
Total EFSI related finance	7007	4461	217	1149	930	2113	5841	8334	153	6723	562	37489

Source: Own analysis based on EFSI 'Infrastructure and Innovation Window' project database.

A few conclusions can be drawn from these figures as to the current sectoral preferences of EFSI:

RES

- 42% of total EFSI clean energy investment is currently going to renewable energy infrastructure.

- All RES investments focus primarily on already established technologies, i.e. those that are already on the market
- Contributions to broader RES investment funds that invest in various RES technologies represent the largest investment volume of EFSI RES-related investments (53%), followed by investments in specific offshore wind projects (43%), and only small shares attributed to biomass and onshore wind (4% and 1% respectively). It is likely that offshore wind is successful in receiving EFSI funding because EFSI is well suited to addressing the barriers faced by this type of project (size type of risks, etc.).

Energy Efficiency

- 58% of total EFSI clean energy investment is currently going to energy efficiency improvements.
- Energy infrastructure and smart meter investments receive by far the largest EFSI contributions compared to other EE sub-sectors (32% and 27% respectively of total EFSI EE investment). The other EE sectors currently receive much less EFSI investment (21% EE- mixed/other infrastructure, 10% EE- transport, 5% EE- commercial buildings, 4% EE- residential housing and 1% EE-industry). The large investment volumes flowing towards energy supply and distribution infrastructure, as well as smart meters, can partly be explained by the larger investment volumes required for such projects and thus their suitability for the type of financial structuring under EFSI. On the other hand, residential housing (at least, in the private sector) primarily requires smaller personal loans for energy efficiency improvements, a financing structure not well suited for the EFSI programme except if these small projects are bundled into larger ones.

It should be noted that the EFSI project database does not contain all the detail necessary for a complete analysis; in particular, additional leveraged finance is often confidential and therefore not disclosed. This means that the current total EFSI-related investment in clean energy projects is in reality most likely higher than €37.5bn. However, the EFSI contribution itself of €8.6bn is comprehensive with respect to clean energy EFSI financing. Out of a current total of €30.2bn up to the end of 2016 for EFSI (direct EIB EFSI finance only) finance for all projects (across all categories)⁷, some 28.4% is estimated as going towards clean energy investment.

The current leverage factor of EFSI finance *overall* (not specific to clean energy) is €30.2 to €163.9bn, or 5.43. In other words, each euro of EFSI finance generates €5.43 of investment in the real economy. We also assessed the leverage factor of the current *clean energy* projects. Including only those projects (of the 62 total) which had both EFSI and total EFSI related finance information available, the clean energy specific leverage factor is 4.92. This slightly lower leverage factor is not unexpected, as clean energy options in general could be considered to have higher risks and therefore typically trigger less additional private and/or public investments than alternative, well-proven investment opportunities in other sectors.

Feasibility of the policy measure

In its Communication (COM(2016)359 final), the Commission confirmed that EFSI (original version) "is firmly on track to deliver the objective of mobilising at least €315bn in additional investments in the real economy by mid-2018". This means the remaining €185bn should be mobilised between mid-2018 and the end of 2020.

⁷ European Fund for Strategic Investments in 2016: http://www.eib.org/attachments/thematic/efsi_in_2016_en.pdf

Additionally, our analysis of the current EFSI project database indicated that an increase to 40% under the 'innovation and infrastructure window' would be able to unlock significant additional finance for clean energy projects.

However, the biggest barrier is likely the issue covered in detail in influencing factor⁸ VII as described in the recent report on 'Assessing the European clean energy finance landscape – implications for improved macro-energy modelling'⁹ prepared under the same European Commission, DG Energy contract as this case study: the lack of sufficient bankable projects in the clean energy sector. If there will not be sufficient investible projects to reach the additional amount, the 40% earmarking would not be able to reach its goal of unlocking the desired levels of clean energy investment in the real economy. The Investment Advisory Hub under the EFSI intends to tackle this barrier in part by offering support for project development. However, it remains to be seen how one can quantify the impact such a measure can have on delivering a steady pipeline of good bankable clean energy projects.

Relevance to influencing factors

As explained above, the key influencing factor relevant for policy measure 1 is Factor VII¹⁰ (shortage of good/bankable investment project opportunities). Overcoming the current shortage of investible projects and building a healthy project pipeline would be necessary in order to implement the policy measure successfully. Scaling the current 15% EFSI 'Infrastructure and Innovation Window' share in clean energy investments to 40% would require a significantly larger pipeline of investible projects.

The proposed policy measure is also sensitive to influencing Factor III (technology risk)¹¹. Technology risks influence the investment decisions of different investor types. With an EFSI earmark of 40% it is likely that more established technologies (i.e. close to bankable) would continue to receive more funding. This is not per se negative, it just signals that EFSI is probably not the most suitable financing instrument for more innovative projects (i.e. with lower technology readiness levels).

Anticipated impacts on targeted financing sources

This section provides an indication of which financial investors would be attracted by the policy measure. The EFSI 'Infrastructure and Innovation' Window is primarily targeting larger investments. Therefore, it is mainly trying to attract co-funding from national promotional banks, commercial banks, and institutional investors. To some extent it also attracts private companies, for example companies wanting to improve the energy efficiency of their production processes. In its current set-up, EFSI is not relevant for small-end users (other than under the SME window which is excluded from the 40% earmarking target).

For the current approved EFSI projects under the 'Infrastructure and Innovation Window', national promotional banks (NPBs) have played a particularly important role in mobilised co-finance, reflecting their complementary product ranges, local knowledge and geographic reach. By mid-2016, nine Member States had committed to

⁸ Following the categorisation set out in Rademaekers, etc. al (2017). Assessing the European clean energy finance landscape - with implications for improved macro-energy modelling. Deliverable D3 Study on the Macroeconomics of Energy and Climate Policies. European Commission, Directorate-General for Energy, Contract no. ENER/A4/2015-436/SER/S12.716128.

⁹ Rademaekers, etc. al (2017). Assessing the European clean energy finance landscape - with implications for improved macro-energy modelling. Deliverable D3 Study on the Macroeconomics of Energy and Climate Policies. European Commission, Directorate-General for Energy, Contract no. ENER/A4/2015-436/SER/S12.716128.

¹⁰ The numbering follows the categorisation in Rademaekers, etc. al (2017).

co-finance projects in the context of EFSI, mostly via their NPBs, for a total of €42.5bn.

Information regarding current leverage factors has been presented in the previous section.

Estimated scale of overall impact on influencing the clean energy finance landscape

One way to assess the estimated scale of the overall impact of this policy measure on influencing the European clean energy finance landscape is by comparing the **estimated clean energy investment needs for delivering the EU's climate and energy targets versus what the EFSI 40% earmark policy measure could deliver:**

40% of the EFSI 'innovation and infrastructure window' (which amounts to about €350bn combined EFSI and leveraged private/public finance when assuming the continuation of the current finance split between 'Infrastructure and Innovation' versus 'SME' windows)¹² will be earmarked as clean energy investments: this amounts to €140bn combined EFSI and leveraged private/public finance. Annually this translates to a total investment of ca. €23.3bn induced by EFSI.

Table II.3 Expected clean energy investment triggered via policy measure 1 (in €bn)

Total EFSI 2.0 by 2020	Total EFSI 'I & I window' by 2020	Total EFSI for clean energy (40% of total EFSI 'I&I window)	Annual EFSI for clean energy
500	350	140	23.3

Source: Own calculations.

According to the latest European Commission's projections (SWD (2016) 405 final), the EU annual additional investments (on top of business-as-usual investment volumes) required over (2021-2030) to reach the EU's 2030 climate and energy targets amount to €177bn (2013 prices) every year.

While EFSI will be implemented through to 2020 and these latest annual additional investment needs estimates are for the period 2021-2030, if we assume similar annual investment needs between now and 2020 then a rough estimate would suggest that investments financed via EFSI could cover about 13% of overall additional investment needs to reach the EU's 2030 climate and energy target and objectives. Notice that the €177bn is in constant prices and that the expected needs are lower in the beginning of the period so the policy measure could possibly cover more than 13% of the investment gap in the initial years.

Another way of interpreting more generally the overall impact a 40% EFSI earmark could make on the clean energy finance landscape is to look at the important role public funds can play in terms of leading by example. This means in particular taking on projects that are slightly too risky for the 'pure' private sector and these projects help demonstrate the profitability of a wide range of projects and bring in more finance in the future. The analysis of the current project pipeline suggests that EFSI (at least currently) is still quite risk averse, and as much of their funds are lent via intermediary national banks, the individual loan decisions may not differ substantially

¹² The total EFSI 2.0 is intended to amount to €500bn. Of this amount, ca. 70% are allocated for the innovation and infrastructure window (based on percentage split between 'SME' versus 'innovation and infrastructure' windows of currently listed EFSI projects). Of this total amount for the EFSI 'innovation and infrastructure window (ca. €350bn), 40% would be earmarked for clean energy projects finance (amounts to ca. €140bn).

from 'normal' loan decisions; riskier RES projects are not present in the existing portfolio. This does not mean that EFSI has no spillover impacts on the financing of the clean energy transition. While it does not cater to higher risk projects, it can still generate positive spillover by creating volume in the clean energy market, which in turn is urgently needed for green securitisation¹³, etc. If EFSI 2.0 should change this and cater to higher risk projects, this could for example be implemented by restricting EFSI finance in the energy efficiency for buildings field to only allow EFSI finance for nZEBs.

Policy measure 2: Testing the implications of the three pillars of the Smart Finance for Smart Buildings (SFSB) initiative

Description of the policy lever

The SFSB initiative is a non-legislative proposal included in the Clean Energy for all Europeans Package. It aims at unlocking private financing and scaling-up energy renovation projects by: supporting the better use of public funds via new and/or up-scaled financial instruments; helping project developers bringing good project ideas to maturity; and making the energy efficiency market more trusted and investible for investors. The initiative is complementary to the existing regulatory framework and financing mechanisms dedicated to energy efficiency in buildings.

The initiative is articulated around 3 pillars:

- **Pillar 1: More effective use of public funding**
The objective of this pillar is to reduce the financial cost of energy renovation projects by providing a guarantee for such projects and bundling existing EU funds (European Fund for Strategic Investment and European Structural and Investment Fund) under the national/regional financing platforms which should be established by Member States.
- **Pillar 2: Aggregation and assistance for project developments**
The objective of this pillar is to reduce the technical/technological cost of energy renovation projects by bundling small projects into larger ones and creating a pipeline of large projects through the proposed One-Stop-Shops which should be established by Member States at regional level.
- **Pillar 3: De-risking through better information**
The aim of this pillar is to make energy renovation projects more attractive to investors by reducing their perceived risk through the availability of certified information about the return on investment.

Feasibility of the policy measure

The SFSB initiative is a good step forward. However, given its non-legislative aspect, Member States may decide to not implement it.

Furthermore, the implementation of the initiative requires establishing two policy instruments (Financial Platforms and One-stop-Shops). The EC has recently launched a tender to benchmark existing financial instruments and announced that EEFIG

¹³ Green securitisation, i.e. the bundling of green loans into securities, can unlock additional capital to finance the transition to a low carbon and climate-resilient economy. Securitisation is a financial tool that facilitates the aggregation of multiple small-scale loans. It has potential to be widely adopted as a vehicle for pooling low carbon and climate-resilient assets into green investible deals. Green securitisation therefore improves access to capital and lowers the cost of capital.

(Energy Efficiency Financial Institutions Group) work will be extended. Furthermore, under H2020, the EC is funding several projects aiming to better understand financial instruments already in use at Member State level but also those in use outside of Europe such as the PACE scheme in the US. The outcome of these various projects will allow for a better support/guidance by the EC in the implementation of the SFSB. The aim is to avoid overlap between the two new instruments (Financial platforms and One-Stop-Shops) proposed in the SFSB and between these two instruments and existing ones at Member State level such as third-party financing.

Moreover, Member States lacking technical capacity may need further technical assistance to establish these two new instruments.

Relevance to influencing factors

Table II.4 maps each pillar to the relevant influencing factors¹⁴ for leveraging investment finance.

Table II.4 Relevant influencing factors for SFSB

SFSB Pillar	Influencing factors to which the pillar is relevant
Pillar 1. More effective use of public funding	<p>Factor I (policy design, regulatory risk and public incentives uncertainties): policy should reduce perceived regulatory risk and simplify public incentives structures.</p> <p>Factor II (commercial necessities): policy should help solve some of the access to finance issues that currently exist.</p> <p>Factor IV (country's enabling framework to support clean energy transition): policy should strengthen the overall support towards zero energy renovations in the building sector</p>
Pillar 2. Aggregation and assistance for project developments	<p>Factor VII (shortage of good investment project opportunities): policy should bring about more bankable projects in theory. In practice this is unclear due to the lack of available technologies and the requirement to renovate.</p> <p>Factor V (Governance and accountability factors): policy could better inform / improve transparency.</p>
Pillar 3. De-risking through better information	<p>Factor II (commercial necessities): policy should give project developers and/or developers improved access to more information in order to improve business models, make better investment decisions, etc.</p> <p>Factor V (Governance and accountability factors): policy could better inform / improve transparency.</p>

Expected effects on targeted clean energy projects

The expected effect is to reduce the renovation cost. This cost reduction is expected to occur at two different levels; i) reduction of financial cost through the guarantee which would be provided under pillar 1, and ii) reduction of the technical/technological cost through project bundling which is expected to take place through the implementation of pillar 2. Project bundling will lead to the industrialisation of energy renovation. The production in factories of prefabricated energy renovation kits for each construction period, climate zone and building type will allow for labour cost reductions and hence a reduction in overall energy renovation costs.

This cost reduction should make energy renovation projects more attractive and hence lead to an increase in energy renovation rates over time.

Expected impacts of targeted financing sources

The SFSB aims at bundling the European Strategic and Investment Fund and the European Structural and Investment Fund through the investment platforms. At this

¹⁴ Following the categorisation set out in *Mapping of the current EU clean energy landscape* (ibid).

stage, it is unclear if the bundling will take place project by project or for the total amount allocated to each Member State.

Estimated scale of overall impact on influencing the clean energy finance landscape

The SFSB targets the buildings sector, and more specifically energy renovation of existing buildings. All buildings (household, offices, etc.) are included.

- For the residential housing stock: 70% of EU population live in owner-occupied dwellings and 60% live in single-family homes. Therefore, consumers need to be encouraged to undertake the investments. But it is difficult to convince individuals because of the high cost of deep/zero energy renovation. Furthermore, the share of owner-occupiers living in single family homes is higher in poorer Member States, where the willingness/capacity to take on debt may be lower. To reduce the financial cost, policy intervention is needed to provide long-term loans and guarantees with low interest rates. Pillar 1 of the SFSB initiative is intended to address this barrier. To reduce the technology/technical cost, policy intervention is needed to bundle small projects into larger ones to offer scope for economies of scale and trigger technological innovation where needed. Pillar 2 of the SFSB initiative is intended to address this barrier. Only in specific cases, such as social housing where ownership is grouped, measures could be bundled, and prices reduced for example. In terms of modelling, pillar 1 should lead to loans with low or zero interest rates. Pillar 2 should lead to reduce direct investments in energy efficiency measures through scaling-up leading to up 10% of cost reduction. Energiesprong in the Netherlands gives a good indication of cost reduction achieved by reducing the financial/technical/technological costs at the same time and by improving the productivity of energy renovation companies. The initial cost of zero energy renovation was 145.000€, by bundling 1300 projects, they divided the cost by 2 for single family homes and almost 3 for multi-family. Today energiesprong offers zero energy renovation at 75.000€ for single family homes and 55.000 € for multi-family. Their target is to be at 40.000€. Analysis of Energiesprong cost data shows that 10% of cost reduction is due to bundling small projects into larger ones (scaling-up effect) while 45% of cost reduction is due to the improvement of the productivity (this included a more integrated and systemic engineering, smarter on-site logistics, the use of building automation models, better collaboration between different companies/contractors). The additional expected cost reduction to reach the target of €40.000/home will come from the use of new material and technologies. Energiesprong cost data confirm a recent assessment of cost reduction conducted by McKinsey¹⁵ for the overall construction sector.
- The policy measure (SFSB) covers renovation only. New buildings are excluded from the policy measures as EPBD requires all new buildings to be 'near-zero-energy-buildings (nZEBs) by 2021 and MSs are introducing this requirement in their building energy codes. The number of new nZEB building is increasing in the most advanced MSs
- Both EE and RES measures in buildings renovations are included/targeted. RES is included because the only way to reach the so-called 'zero energy renovation' is by adding a RES component. The proposed smartness indicator and the objective to consider buildings part of the EU energy system require including RE measures, where technically feasible, in energy renovation projects.

¹⁵ Reinventing Construction Through Productivity Revolution, Mckinsey, 2017.

The following table provides an analysis regarding the intended impact of the three pillars towards the buildings sector and comments on the issues affecting its scale of impact.

Table II.5: Channels and issues affecting impact of SRSB pillars

<i>SFSB Initiative</i>	<i>Targeted/intended impact on the building sector</i>	<i>Comments</i>
Pillar 1. More effective use of public funding	<ul style="list-style-type: none"> • Making energy renovation projects cost-effective by reducing the financial risk and cost through long-term loans with low interest loans (public guarantee of such loans should reduce the perceived risks of financial institutions) • Easier access to finance by bundling EU funding dedicated to energy renovation 	<ul style="list-style-type: none"> • When interest rates are higher, and in MSs where interest rates are already high, the public guarantee should allow to a reduction in financial risk and the interest rate faced by borrowers • Bundling of public finance should help solve provision of finance issue for zero/ deep energy renovations.
Pillar 2. Aggregation and assistance for project developments	<ul style="list-style-type: none"> • Large scale renovation projects to reduce the technical/technological cost • Large scale renovation projects would have the effect that one decision-maker would interact with financial institutions instead of several negotiating smaller finance packages. It is expected that decision maker will have the expertise needed to better understand existing financial instruments and how to optimise their use. • Aggregation of small projects to address owner-occupiers / single family homes. • Speeding up the built of the technical capacity needed to access the finance pillar 1 should make easier to access 	<ul style="list-style-type: none"> • Could help specific sub-sectors within buildings (e.g. social housing) to reduce the technological costs of zero energy renovations. • There is a lack of policy instrument which would lead to bundling single family homes and to address the ownership issue in multi-family buildings. • Need to link to regulatory instruments (e.g. prohibition of rent/sale of non-renovated homes or introduction of energy renovation obligation when facades are renovated).
Pillar 3. De-risking	<ul style="list-style-type: none"> • Reducing the perceived risk of energy renovation projects by investors through standardised information 	<ul style="list-style-type: none"> • There is not enough evidence in the literature about how information tools change the perceived risk by investors. • Deep platform is marketed as an open source database. DEEP provides pay-back time for single measures but the cost of the measure is not available. The building observatory does not include cost data either: it refers to ZEBRA (one of the H2020 projects) which provides sparse cost data in a few Member States.

Part III Modelling approach and results

Earmarking 40% of EFSI 2.0 projects under the 'infrastructure and innovation window' towards clean energy transition projects

Scale and timing

EFSI 2.0 increases the EU guarantee for EFSI projects from €16bn to €26bn and EIB capital from €5bn to €7.5bn, supporting an expected total private and public investment of at least €500bn (up from €315bn). EFSI was initially established for a period of three years (2015-2018), and is now extended until 31 December 2020. The additional finance from EFSI 2.0 is therefore €185bn.

Of this amount, if we use the percentage split between 'SME' versus 'innovation and infrastructure' windows in currently-listed EFSI projects, some 70% (about €130bn) would be allocated to the innovation and infrastructure window. Of this, 40% (€52bn) would be earmarked for clean energy projects finance. This compares with this report's estimate of €37.5bn already committed to clean energy projects according to the EFSI projects database (see Table II.1 above).

Some 42% of total EFSI clean energy investment is currently going to renewable energy infrastructure; the remaining 58% is currently going to energy efficiency and other decarbonising improvements (of which 53% is going into energy and mixed/other infrastructure. 27% into smart meters, 11% into EE buildings and industry and 10% into EE transport).

These shares are used as a benchmark for the analysis of EFSI 2.0 presented below. Hence, EFSI 2.0 public and private investment in *renewable energy infrastructure* would be 42% x €52bn = €21.8bn (in nominal terms). In past experience, 43% of EFSI (public plus private) renewable energy finance went into offshore wind, almost all of the rest into 'mixed' schemes. Similarly, EFSI 2.0 public and private investment in *energy efficiency and other decarbonising improvements* would be 58% x €52bn = €30.2bn (in nominal terms).

Modelling approach and results

The modelling approach seeks to represent the impact on investment in renewables (and then the impacts on energy use, emissions and the wider economy) of this additional finance in the two energy-economy-environment models: E3ME and GEM-E3-FIT. Both include a detailed treatment of power generation, distinguishing different technologies and hence allowing an explicit representation of the policy intended to stimulate greater investment in renewables. The model simulations work by changing the cost of capital for selected renewables technologies and observing the impact on the scale and pattern of investment.

In both models, it is assumed that *the same addition to power generation capacity would have occurred* with and without EFSI 2.0, because it is assumed that the overall scale of capacity (adjusted for differences in load factors between technologies) that is built in power generation is determined by projected demand (plus replacement), and that projected demand is not much affected by this specific policy. Hence, the EFSI 2.0-funded investment involves a substitution of investment in near-commercial

renewable technology projects for other electricity generation investment. The question is: what is the nature of that alternative investment that has been displaced?

The two models have different approaches to the modelling of the factors influencing the choice that investors make with respect to technology for power generation (GEM-E3-FIT focuses on a comparison of costs of alternative investments; E3ME's FTT:Power approach makes the rate of diffusion of a technology that is cost-effective depend also on its existing market share. This approach assumes that there are a variety of investors with different preferences with respect to their disposition to invest in different technologies for any given cost differential. These differences are interpreted as reflecting uncertainty, giving rise, among other things, to different perceptions about the potential for capital cost overruns and the price that will be earned when the electricity is sold. There is less uncertainty for a technology with a larger market share (thanks to the experience that has been gained from past investments). The consequence is that, instead of there being a single technology that the model treats as 'marginal' for a homogeneous group of investors, decisions by heterogeneous investors lead to investment across a number of technologies.

Hence, in a simulation in which the cost of capital for one or more renewables technologies is reduced, FTT:Power may displace investment in a number of other technologies. The modelling in E3ME tried a number of sensitivity scenarios with alternative changes to the cost of capital for selected technologies. Because the existing share of offshore wind in the market is currently small, FTT:Power penalises this technology heavily, and even with an assumed 5 pp cut in the cost of capital, there is little impact on investment in this technology. The fact that the initial projects funded by EFSI so far includes offshore wind projects suggests that the penalty introduced by FTT:Power may be too strong (or that the projects are also supported by national policies that improve their attractiveness further).

Following this sensitivity analysis, the scenarios modelled in E3ME and GEM-E3-FIT and presented here assumed a 2 pp cut in the cost of capital for wind, including onshore wind, and solar PV. Although some onshore wind and solar PV projects are commercially viable with existing incentives, it is assumed that there are some whose commercial viability is marginal and which could be eligible for EFSI 2.0 finance.

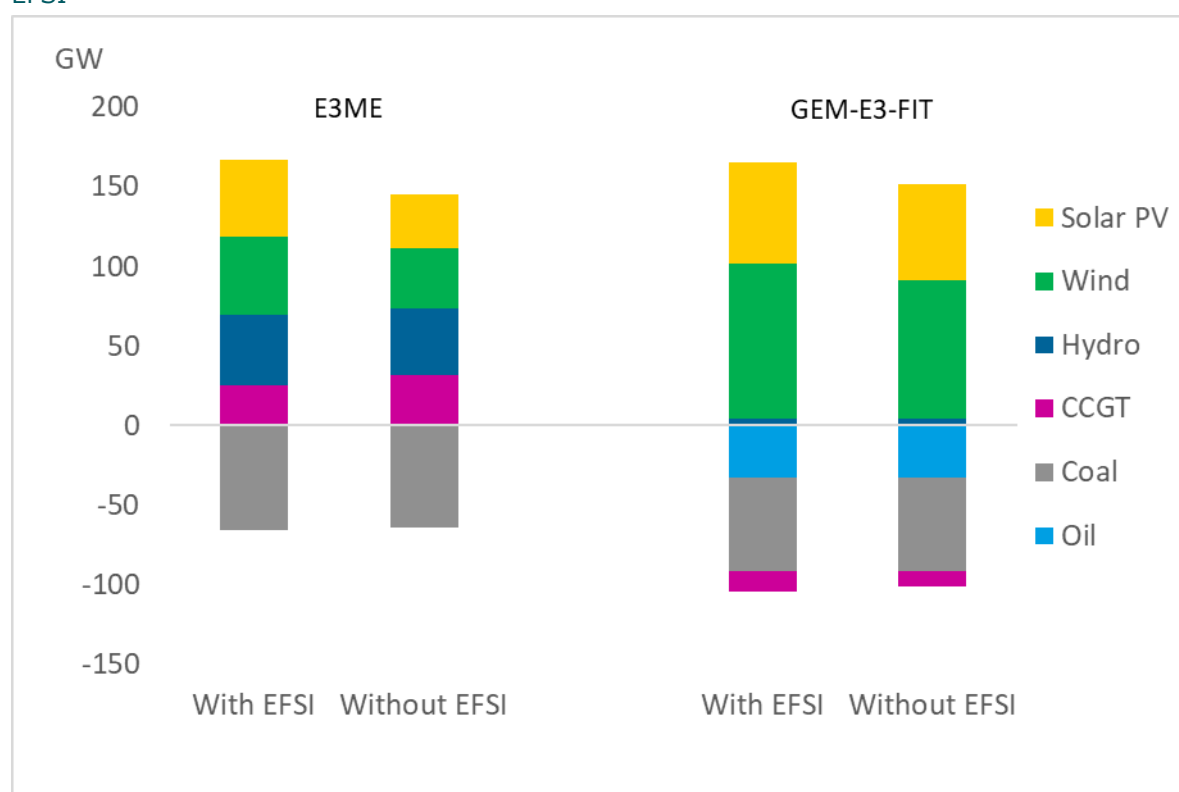
Figure III.1 shows the results of the two models for the changes in EU28 power generation capacity over the period¹⁶ to 2025, with and without the assumed impact of EFSI 2.0 on financing costs. In the baseline scenario, without EFSI 2.0, GEM-E3-FIT has a stronger shift out of fossil fuels and into renewables: its results suggest substantial retirement of oil-fired capacity and some net loss of CCGT capacity, whereas E3ME has no change in oil-fired capacity and further investment in CCGTs; GEM-E3-FIT therefore has greater investment in renewables capacity. The difference between the two models' results is consistent with the penalty in the diffusion treatment in FTT:Power for technologies whose market share is small.

Despite these differences in the baseline scenario, there is greater convergence between the two models regarding the *impact* of the lower financing costs for renewables assumed to be brought about by EFSI 2.0, which is represented by the *differences* between the with- and without-EFSI 2.0 cases. This is summarised in Table III.1, which shows the difference between these two cases for investment in power generation capacity by technology over the period to 2025. Both models predict a substantial impact on investment in wind projects at the expense of CCGT

¹⁶ GEM-E3-FIT operates in 5-year time-steps, and so the results for both models are shown as changes from 2015-2025.

investment. They also predict an increase in investment in solar PV, but this effect is considerably larger in E3ME than in GEM-E3-FIT. Consequently, in E3ME the total additional investment in renewables is somewhat larger than the €21.8bn envisaged in the pre-model analysis of EFSI 2.0; some of this investment is in the period after EFSI 2.0 financing comes to an end, reflecting the persistent impact of the boost given to the market share of renewables. In both models investment expenditures are higher than in the non-EFSI case, even though it is assumed that the addition to capacity (adjusted for load factors) is the same, because the renewable technologies are more capital-intensive.

Figure III.1: Predicted changes to EU28 power generation capacity, 2017-2025, with and without EFSI



Note: The chart shows the predicted change in capacity between 2015 and 2025 in the two scenarios. It shows the impact of a 2 pp cut in the rate for wind and solar PV investment, bringing the rates into line with that charged for conventional technologies such as CCGT. Source: E3ME, GEM-E3-FIT (BA cf SA1A).

Table III.1: Model estimates of impact of EFSI 2.0 renewable energy projects on investment in selected power generation technologies

Accumulated investment 2015-25, difference between scenarios with and without EFSI 2.0.	E3ME €2013m	GEM-E3-FIT €2010m
Wind	14816.0	15181.8
Solar PV	10413.7	3550.6
CCGT	-3460.5	-2305.5

Notes: The data are in the prices of the year shown; the price deflator is little-changed between these years. The figures show the impact of a 2 pp cut in the rate for onshore wind and solar PV investment, bringing the rates into line with that charged for conventional technologies such as CCGT.

Source: E3ME, GEM-E3-FIT (BA cf SA1A).

The effect on *generation* once new capacity is built is mainly to displace gas-fired generators, as shown in Table III.2

Table III.2: Predicted impact of EFSI 2.0 renewable energy projects on power generation from plants based on selected technologies

Source: E3ME (BA cf SA1A).

Difference between scenarios with and without EFSI 2.0.	E3ME		GEM-E3-FIT	
	2020	2025	2020	2025
	TWh			
Wind	10.5	23.6	26.7	17.9
Solar PV	2.2	16.9	7.8	5.2
CCGT	-6.9	-33.5	-7.0	-16.1

The impact on overall GDP (an increase of some 0.05%) reflects the scale of the investment: €15-20bn (net) over 8 years compared with total EU28 investment of a little under €3,000bn in 2016. In GEM-E3-FIT, the impact of a higher unit cost of electricity in the period after 2020 (due to the higher LCOE of PV and wind relative to gas) is sufficient to reduce GDP by 0.02% in 2025.

At the sectoral level there is an increase in production and employment in wind and PV manufacturing.

Table III.3: Predicted impact of EFSI 2.0 renewable energy projects on sectoral production and employment.

Accumulated effect 2015-25, % difference between scenarios with and without EFSI 2.0.	GEM-E3-FIT	
	Production	Employment
Fossil fuels	-0.1%	-0.1%
Wind equipment manufacturing	3.8%	3.8%
PV manufacturing	2.2%	2.1%

Source: GEM-E3-FIT (BA cf SA1A).

It is more challenging to model the investments funded under *energy efficiency and other decarbonising improvements* (hereafter, 'EEO') which comprise the remaining 58% (€30.2bn) of EFSI public and private funding for clean energy as the project descriptions in the EFSI database of existing projects are quite varied. About half of the EEO funding for existing projects is going into various kinds of energy and related infrastructure: this includes upgrading, replacement and extension of gas and electricity distribution networks including some interconnectors. Some (extended gas distribution) will have the effect of substituting natural gas for other fossil fuels. About 10% of existing EEO funding is going into transport, a mix of funding for R&D into greater energy efficiency / reduced emissions for vehicles and funding to support the purchase of public transport vehicles running on alternative fuels. The remaining 40% of EEO funding is largely in projects to promote energy efficiency in buildings (including a substantial part for smart meters).

We have focused the modelling of the EEO element of EFSI 2.0 on the part that brings about investment in greater energy efficiency in buildings. It is assumed that the same proportion of EEO funding as in the initial phase of EFSI is taken up in loans for investment in energy efficiency. Hence, it is assumed that $40\% \times \text{€}30.2\text{bn} = \text{€}12.1\text{bn}$ (in nominal terms) is spent at a rate of $\text{€}3.02\text{bn}$ per year over 2017-20, divided equally between residential and commercial buildings (assumed to be in service sectors).

The impact is to reduce EU28 energy use across all sectors in 2020 by about 0.5% compared with the no-EFSI case (and by more in households than in commercial buildings)¹⁷. The models were run through to 2025 for consistency with the earlier RES analysis. In the case of this EEO element, the additional investment is introduced by assumption and ends in 2020, and the results in subsequent years capture the fact that, once the investment is made, the impacts on energy efficiency of buildings are sustained.

Table III.4: Predicted impact of EFSI 2.0 energy efficiency projects in buildings on EU28 energy use

	E3ME		GEM-E3-FIT	
	2020	2025	2020	2025
	'000 toe			
Power own use & trans.	-3099.0	-1389.0	-3281	-3158
Households	-5419.0	-6836.0	-6587	-6203
Service sectors (excl. transport)	-1291.0	-1404.0	-1125	-1111
Whole economy	-9344.0	-9222.0	-10743	-10179
	%		%	
Power own use & trans.	-0.8%	-0.4%	-0.9%	-0.8%
Households	-1.9%	-2.5%	-1.3%	-1.2%
Service sectors (excl. transport)	-0.9%	-0.9%	-0.5%	-0.5%
Whole economy	-0.5%	-0.5%	-0.6%	-0.6%

Note: 'Whole economy' includes uses not shown in the table (e.g. manufacturing, transport).

Source: E3ME (BA cf SA2).

The estimated economic impact is an increase in GDP of about 0.05% in 2020 and 2025.

Taking the two kinds of EFSI impacts together (the additional RES investment *and* the additional energy efficiency investment), the impacts on energy use are shown in Table III.5.

Compared with the energy efficiency impacts alone shown in Table III.4, the results of the combined package show:

- a larger increase in GDP (0.1% rather than 0.05%) in both 2020 and 2025, reflecting the addition of the RES investment
- a *larger* reduction in energy use in power generation, reflecting the lower demand for electricity in buildings brought about by the investment in energy efficiency

¹⁷ The impacts on *absolute* energy use at sector level are similar in the two models, the *percentage* impacts differ because the models are not constrained to have the same level of energy use in the non-EFSI case.

- a *smaller* reduction in energy use by households and service sectors, reflecting the higher GDP and incomes
- a *larger* reduction in economy-wide energy use by 2025 (the net effect of the two influences; the other sectors not shown in the table have slightly higher energy use due to higher GDP)

Table III.5: Predicted impact of EFSI 2.0 renewable energy and energy efficiency projects on EU28 energy use

	E3ME		GEM-E3-FIT	
	2020	2025	2020	2025
				'000 toe
Power own use & trans.	-3544.0	-7428.0	-4336	-9412
Households	-5122.0	-6615.0	-6216	-6498
Service sectors (excl. transport)	-811.0	-1096.0	-780	-1210
Whole economy	-7705	-13769	-10429	-17152
				%
Power own use & trans.	-0.8%	-2.0%	-1.2%	-2.4%
Households	-1.5%	-2.0%	-1.2%	-1.3%
Service sectors (excl. transport)	-0.4%	-0.6%	-0.3%	-0.5%
Whole economy	-0.4%	-0.8%	-0.6%	-1.0%

Note: 'Whole economy' energy use includes uses not shown in the table (e.g. manufacturing, transport).

Source: E3ME, GEM-E3-FIT (SA2 cf SA1A).

Smart Finance for Smart Buildings (SFSB)

The SFSB initiative is intended to operate via three pillars designed to increase the attractiveness of projects for private finance.

Modelling approach and results

The approach has been to model the impact of achieving the Commission's ambition for the scale of additional investment in energy efficiency in buildings brought about by the initiative, namely an additional €10bn (of both public and private funds) by 2020¹⁸. It is assumed that the funds are spent in equal amounts over the four years to 2020.

The Commission's ambition describes the investment as additional, and so the assumption is that investment in energy efficiency in buildings is higher by this amount. We make no assumption about any reduction in investment in other areas due to diversion of funds. For the public funds element, diversion would probably be a reasonable assumption (the description of the first pillar refers to 'more effective use of public funding') but from what alternative is unclear. If it is from other energy efficiency programmes that are less effective, then the 'additional' €10bn estimate can be taken as meaning the *net increase in funding* (taking account of reductions in other programmes). For the private funds element, the extent of diversion depends on the factors relevant to 'crowding out' discussed in the earlier case study report undertaken

¹⁸ See http://europa.eu/rapid/press-release_MEMO-16-3986_en.htm, 30/11/16.

during this project, *Capacity constraints and macroeconomic performance*¹⁹. For simplicity here, we simply assume that investment in energy efficiency in buildings in the absence of the SFSB initiative is lower by the scale of additional investment represented by the Commission's ambition.

It is assumed that the energy savings per € spent on investment in energy efficiency in buildings is the same as was assumed in the economic modelling analysis for the impact assessment of the Energy Performance of Buildings Directive. We then implement the additional investment and the associated change in energy consumption.

The results from the modelling are shown in Table III.6 and Table III.7. They reflect the assumption that energy savings per euro spent are considerably larger in households than in commercial buildings²⁰. The tables also show the knock-on consequences for power generation of reduced electricity use in buildings. The impacts on CO₂ emissions from households and service sectors are larger than the impacts on energy use, reflecting the greater share of fossil fuels than electricity for heating.

Table III.6: Predicted impact of SFSB energy efficiency projects in buildings on EU28 energy use

	E3ME		GEM-E3-FIT	
	2020	2025	2020	2025
				'000 toe
Power own use & trans.	-2638.0	-1133.0	-2721	-2619
Households	-4475.0	-5664.0	-5462	-5145
Service sectors (excl. transport)	-1071.0	-1174.0	-932	-920
Whole economy	-7771.0	-7639.0	-8907	-8441
				%
Power own use & trans.	-0.7%	-0.3%	-0.7%	-0.7%
Households	-1.6%	-2.1%	-1.0%	-1.0%
Service sectors (excl. transport)	-0.7%	-0.8%	-0.4%	-0.4%
Whole economy	-0.4%	-0.5%	-0.5%	-0.5%

Note: 'Whole economy' includes uses not shown in the table (e.g. manufacturing, transport).
Source: E3ME (BA cf SB).

¹⁹ Available at <https://ec.europa.eu/energy/en/data-analysis/energy-modelling/macro-economic-modelling>

²⁰ While the impacts on *absolute* energy use are similar in the two models, the *percentage* impacts differ because the models are not constrained to have the same level of energy use in the non-SFSB case.

Table III.7: Predicted impact of SFSB energy efficiency projects in buildings on EU28 CO2 emissions

	E3ME		GEM-E3-FIT	
	2020	2025	2020	2025
				mtCO2
Power own use & trans.	-8.2	-3.2	-7.1	-6.2
Households	-11.6	-15.3	-7.5	-6.8
Service sectors (excl. transport)	-3.6	-4.4	-0.7	-0.6
Whole economy	-22.2	-22.1	-15.0	-13.2
				%
Power own use & trans.	-0.7%	-0.3%	-0.7%	-0.7%
Households	-3.0%	-4.1%	-0.8%	-0.7%
Service sectors (excl. transport)	-2.4%	-3.4%	-0.4%	-0.4%
Whole economy	-0.6%	-0.6%	-0.5%	-0.4%

Note: 'Whole economy' includes uses not shown in the table (e.g. manufacturing, transport).
 Source: E3ME (BA cf SB).

Again, the GDP impacts reflect the scale of the assumed boost to investment and the subsequent income effects arising from lower energy expenditures; GDP is about 0.06% higher by 2020 and 0.07% in 2025.

Finally, a scenario was modelled in GEM-E3-FIT to focus on the impacts on selected countries in which country risk makes the cost of finance particularly high for household borrowers, on the grounds that SFSB might be of particular importance in these circumstances. In the scenario, the REF interest rate faced by households in Greece, Italy and Spain for the financing of energy efficiency measures for heating was reduced by 2pp. Table III.8 shows the results. The lower financing cost stimulates additional spending of €175m-€200m (2011 prices), or 4.7-5.5% in Spain and Italy, and by rather less in Greece. However, the impact of energy use for heating is very small.

Table III.8: Testing the impact on household energy for heating of lower interest rates

			2016-20 (cumulative)		
			Greece	Italy	Spain
GEM-E3-FIT					
REF	Household expenditures on energy efficiency for heating	€m (2011 prices)	619	3671	3745
	Household energy use for heating	'000 toe	9482	86966	21029
Lower interest rates (2pp)	Household expenditures on energy efficiency for heating	€m (2011 prices)	637	3872	3922
	Household energy use for heating	'000 toe	9481	86950	21025
Difference	Household expenditures on energy efficiency for heating	%	2.8	5.5	4.7
	Household energy use for heating	%	-0.011	-0.019	-0.022

Source: GEM-E3-FIT.

Part IV Conclusions

Channels of impact

In both models, the principal route for changes in the clean finance landscape to affect investment in clean energy operates via the interest rate faced by borrowers. The policy initiatives are expressed in terms of scale (the additional funding expected to be levered in), and with some underpinning logic regarding the obstacle / market failure that it is intended to address. Where the nature of the initiative cannot readily be translated into a reduction in the cost of capital, the impact has been modelled by introducing additional investment in line with the scale of ambition of the policy, and to represent its impact on energy efficiency (as well as the wider economic impacts on supply chains and incomes).

EFSI 2.0 funding for RES

In the case of EFSI 2.0 renewable energy funding, the way that this was approached in the modelling was to

- assume an existing penalty for non-mature RES technologies
- assume that the impact of EFSI funding is to remove this penalty
- examine the difference for investment in capacity and in the choice of technology between a no-EFSI and an EFSI case

The models are well-suited for this analysis in that they

- distinguish explicitly the different technologies used in power generation
- model the need for new capacity on the basis of the demand for electricity that comes from the various kinds of users in the economy
- incorporate explicitly the interest rate in the choice of technology in which power generation investment

The two models give different results because of their different treatment of the take-up of new technologies in power generation. In the absence of the EFSI 2.0 initiative, GEM-E3-FIT has a stronger shift than E3ME out of fossil fuels and into renewables on the basis of the existing incentives. The smaller shift in E3ME is consistent with the penalty in the diffusion treatment in FTT:Power for technologies whose market share is small, even if they appear more attractive on the basis of relative costs, reflecting uncertainty about whether the expected profitability will be realised. In both models, the impact of EFSI 2.0 is to give a substantial boost to investment in wind projects at the expense of CCGT investment. They also predict an increase in investment in solar PV, but this effect is considerably larger in E3ME than in GEM-E3-FIT: in effect, EFSI 2.0 triggers in E3ME some of the solar PV investment, reflecting that GEM-E3-FIT predicts would come about under existing incentives. In E3ME the total additional investment in renewables is somewhat larger (including investment that continues in the period after EFSI 2.0 financing comes to an end) than the €21.8bn envisaged in the pre-model analysis of EFSI 2.0, whereas in GEM-E3-FIT the boost to renewables investment is less than the €21.8bn figure.

Hence, the modelling concludes that EFSI 2.0 will promote greater investment in wind and solar PV power generation capacity. The scale of impact (i.e. the extent to which the investment proves to be additional to what would have happened otherwise) depends on the assessment of the extent to which investment is currently held back

not just by the expected return on investment but also uncertainty over that return. The impact is larger in the case of the model (E3ME) that puts greater weight on that uncertainty.

EFSI 2.0 and SFSB funding for energy efficiency

The approach taken in the modelling of the impacts of the initiatives that promote greater energy efficiency investment was to

- assume that the stated scale of ambition for spending that the policy would lever in is, in fact, achieved
- implement the investment with assumptions drawn from other analysis for the energy savings that would be achieved per euro spent, distinguishing (as the models and energy savings evidence do) between residential and non-residential investment
- examine the wider economic consequences of the change in investment and energy use

The impact is to curb energy use in buildings across all fuels. The two initiatives are broadly similar in ambition, and so their scale of impact is similar: both produce a reduction in EU economy-wide energy use (including the use of energy in power generation, which is reduced in response to lower final demand for electricity) in the range 0.5-0.7% by 2025; the percentage impacts on CO₂ emissions are of a similar size. In both cases, the GDP impacts (in the order of a 0,05% increase) reflect the scale of the assumed boost to investment and the subsequent net income effects arising from lower energy expenditures versus the financing cost associated with the investment.