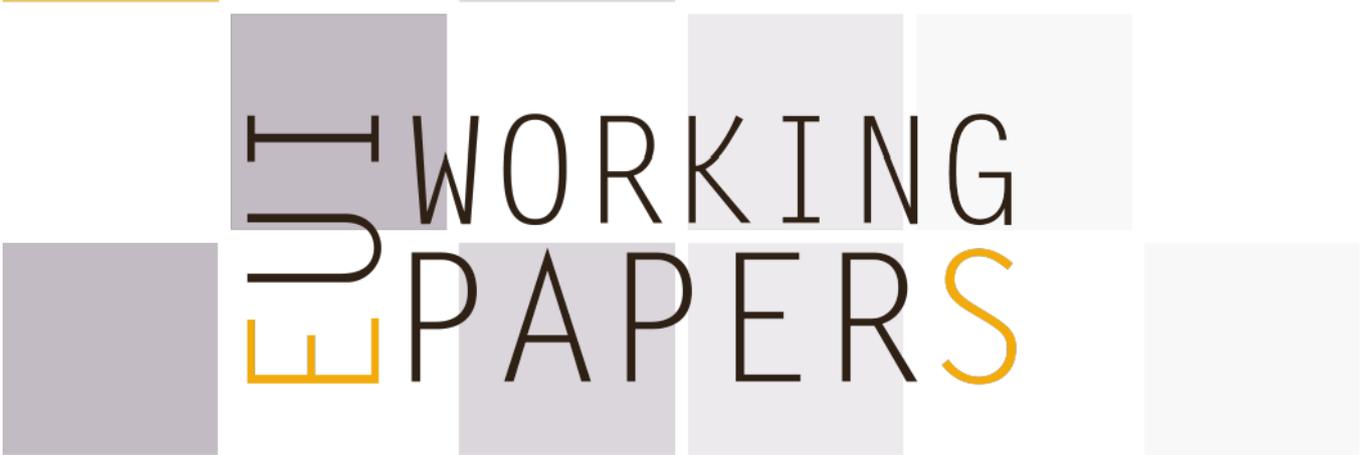




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Robert Schuman Centre for Advanced Studies
Florence School of Regulation

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Christy Petit and Pierre Schlosser

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Abstract

The purpose of this paper is to take stock of green securitization's rationale, potential and pitfalls. It does so by first describing what green securitization is, and, identifying the diversity of asset-backed securities' types used. The specificities of green securitization are illustrated with examples and two deeper case studies. A critical assessment on benefits, risks, costs and limitations of green securitization in fostering green finance is then provided. Before concluding, the paper also engages with public incentives and general public support measures that could sustain the growth of green securitization.

Keywords

Securitization; Structured Finance; Green Finance.

1. Introduction*

Securitization appears to have found a new field in which it can flourish: green finance. Over the past decades, securitization – i.e. the transformation of illiquid assets (typically loans) into liquid assets such as asset-backed securities – has progressively spilled out of its traditional and narrow residential mortgage debt remit.

The market for so-called green securitization has significantly expanded the last five years, in particular in the United States but also, although more marginally, in France and the Netherlands, for instance¹. The green finance segment sees the emergence of new financial instruments or indeed existing instruments applied to the green finance area almost every month and one might therefore wonder why green securitization should deserve attention.

Green securitization brings with it both business opportunities and regulatory challenges. The market development of green securitization can partly be explained by a fertile ground in the green real economy. The transition to ‘net zero’ (Perkins, 2020) will require to shift from a conventional energy production model based on oil, coal and gas towards renewable energies and possibly batteries. The first implication of this significant transformation in energy production technologies is that we will move from a centralized energy system to a decentralized system, because new renewable energies (such as wind and solar) and batteries come in small capacities. This is particularly true when they are compared to coal and nuclear power plants. As a result, energy finance may shift from an approach in which a small, concentrated number of highly capital intensive large-scale capacities financed by large banks towards a model in which numerous and fragmented lower cost and small-scale investments financed by capital market investors. Capital markets, which relies on an incredible diversity of actors, will indeed be crucial to accompany this change towards a more fragmented reality.

Overall, institutional investors may use securitized assets as a source of funding to finance small-scale assets aggregated in portfolios. Such funding can finance in particular small and medium-size enterprises (SMEs) which are plentiful in the green business segment, for example for energy efficient loans, rooftop solar panels, electric vehicles loans and wind mills.

This paper draws on different approaches to green assets included within the process of green securitization conceptually first, and, then applied to specific examples and case studies. Green securitization, still in an early phase in the market development, faces many challenges, either in terms of costs, risks, and limitations. Nevertheless, there are opportunities in green securitizing financial products for which several policy incentives could help, in particular in leveraging such tool for the broader transition of our economies.

2. Typology of assets used in green securitization

Different green assets already exist on the market: loans financing energy efficient assets, for instance housing, windmills, or solar panels. As just mentioned, green securitization is the transformation of such illiquid green assets into securities which are tradable. Financial assets of diverse types ‘back’ financial instruments called broadly ‘securities’, hence the name ‘Asset-Backed Securities’ (ABS). In the following we refer to a typology of green ABS that captures different types of assets.

Before examining this typology, what is the scope of ‘green’ securitization? There are two dimensions of relevance when assessing whether a securitization can be called green. A security is green

* We thank Prof. Bart Joosen for his comments on an earlier draft.

¹ To the best knowledge of the authors, there is no aggregated data that reports on the green securitization market in Europe, hence this paper develops key illustrations without pretending to be exhaustive.

‘when the underlying cash flows relate to low-carbon assets or where the proceeds from the deal are earmarked to invest in low-carbon assets’, according to a definition by the Climate Bonds Initiative – CBI (CBI, 2018). This proposed definition includes a green cash flows dimension; alternatively, a ‘green’ investment from the proceeds of the securities. Like for classical forms of securitization, the logic may be to liberate regulatory capital on financial institutions’ balance sheets, a capital relief that allows further capacity for business.

2.1 Underlying cash flows of the securities stemming from low-carbon assets

First, the underlying cash flows of the securities may stem from low carbon assets. The latter, for instance mortgages or leases, are pooled into a dedicated underlying portfolio and categorised in low-carbon/energy saving categories, prior to the issuance of the securities. More precisely, the underlying portfolios can comprise diverse financial assets such as mortgages on certified buildings, loans/leases on electric vehicles and hybrids, loans for energy efficiency improvements, loans/leases on solar (Climate Bonds Initiative, 2018). The below examples – Green River building from Goldman Sachs, Toyota, Renovate America, and SolarCity, respectively – all constitute some types of ABS. Investors buy the ABS bonds that give them a return (in cash flows) liberated from the underlying assets. In this scenario, the underlying assets are green or low-carbon. Some have argued that this should be the only acceptable approach to green securitization.

2.2 Investment in low-carbon assets

Second, the securities may foster an investment in low-carbon assets. This alternative model may consist in divesting brown assets (or reducing an institution’s credit risk exposure to future cash flows) but dedicating all the proceeds brought in by the deal to green investments. As we will see this brown-proceeds-based securitization has upsides and downsides. On the one hand, it might partly reduce the risks of stranded assets, which stem from existing fossil fuel reserves and carbon-intensive activities (Bolton et al., 2020). On the other hand, this could ‘lock in’ carbon (see below the example with Crédit Agricole in 2017).

2.3 Green securitization: a typology of assets put into perspective

Green securitization may also include in its scope three sub-categories, i.e. ‘green collateral securitization’, ‘green proceeds securitization’, and ‘green capital securitisation’ as proposed by two practitioners observing the growth in the green securitization market (James and Parker, 2019).

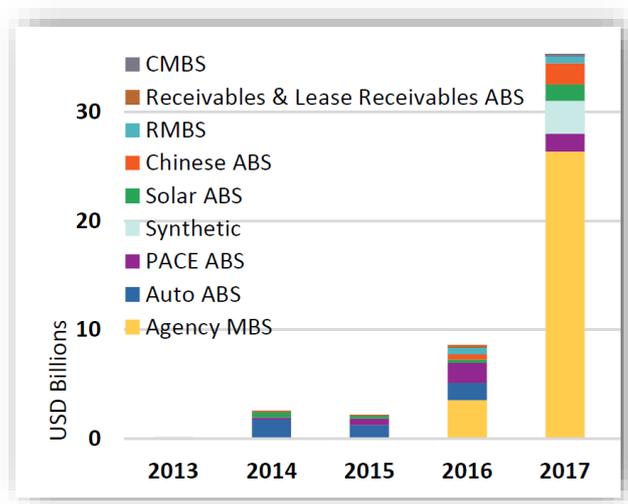
Firstly, green collateral securitization – i.e. a transaction in which bonds issued are backed by a pool of green assets – may facilitate the issuance of new green asset classes and foster the variations of existing asset classes. For instance, an auto ABS deal could be a loan secured on electric vehicles, which constitute green assets. In contrast, the auto ABS may also be backed by existing vehicle leases that are brown assets (see Toyota’s auto ABS below). Within this category of green collateral securitization, the underlying cash flow cannot rely on carbon assets even at a ‘low’ level (as previously envisaged).

Secondly, green proceeds securitization relates to the use of the proceeds in the whole securitization process. In this regard, the proceeds resulting from the issuance of green ABS bonds are allocated to investing solely in green projects. Within this category of green proceeds, there is ultimately a green investment, which corresponds to the alternative approach put forward in the CBI’s above definition. Finally, green capital securitization may be a more specified element of the former category of the use of the proceeds. Green capital securitization consists in using the freed-up capital or potential leverage from securitization to invest in green projects.

There are various types of ABS and their relative issuance volumes differed quite extensively over the past years as the graph below shows (Climate Bonds Initiative, 2018). The ABS issuances have

different characteristics and have been growing significantly over years when it comes to Agency Mortgage-Backed Securities (Agency MBS), which signals the readiness of governmental institutions to invest in this market.

Fig. 1: ABS Issuance by asset type



(Source: Climate Bonds Initiative, 2018)

In the below table, we recap the various types of assets usually considered for green securitization. Next to each type of asset, we provide a concrete example on which we elaborate in the following section.

Table 1: Overview of the examples developed by asset type

Type of assets	Example examined
Agency MBS	Fannie Mae and Freddie Mac
Synthetic ABS	Crédit Agricole
RMBS	Obvion
CMBS	Goldman Sachs
Auto ABS	Toyota
PACE ABS	Renovate America
Solar ABS	SolarCity and its competitors FlexiGroup

(Source: own elaboration)

2.4 The potential of green securitization

Overall, green ABS are mainly represented by mortgage backed securities and by securities backed by loans issued for energy efficiency improvements. (Climate Bonds Initiative, 2018). These green ABS are further exemplified below with PACE ABS, solar ABS and auto ABS among others. Issuance figures have dramatically expanded in recent years. In the long term and according to the OECD, the green ABS issuance on all segments could amount to 280 to 380 billion dollars a year in the period 2031-2035. (OECD, 2017)

In the short term, demand in the European markets seems to remain relatively low. And, mainly banks provide capital for low carbon investments. This is why the Association for Financial Markets in Europe (AFME) stressed the benefits of green securitization could be significant: ‘although demand for green securitisation bond is still relatively low at present, many institutional investors (...) have increased their commitment to invest in green assets in line with their policy objectives. AFME’s members are also seeing an increasing number of queries and reverse enquiries around green securitisations and believe the market has considerable potential to grow’ (AFME, 2019). Beyond the benefits that green securitization may bring to both private finance and energy actors, a deep green ABS market could for example bring significant benefits to central banks who consider implementing Green Quantitative Easing programmes over the years to come.

3. Market Developments: An Overview

In this section we provide a few examples to illustrate the market development of green securitization. As we mentioned in passing, there are different green assets on the market: loans financing energy efficient assets, housing, windmills or solar panels. The green securitization market also features large geographic disparities. Generally, the United States are leading the pack. In the European Union, despite a still limited market size, France and the Netherlands seem to be ahead of others. Overall, the investors’ demand for green securitization is picking up in Europe.

We illustrate first the green ABS types with selected examples and secondly with two case studies. The deeper case studies look at two new green asset classes which have been developed in the US energy sector.

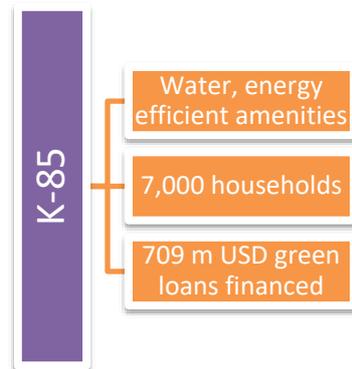
3.1 Selected examples by asset type

The asset types are exemplified in the same order as table 1.

First, there is **Agency Mortgage-Backed Securities (MBS)**. It exists for now mostly in the US, in particular with the governmental agencies, Ginnie Mae, Fannie Mae and Freddie Mac. Those agencies purchase mortgage pools and secure refinancing of these assets in the MBS market. Fannie Mae and Freddie Mac are the two actors relevant for green MBS with their respective programmes targeting US housing. For instance, Fannie Mae issued its first green bonds in 2012 with the Multifamily Green Initiative Program. To give an order of magnitude, the Agency issued 51.7 billion euros in green MBS from 2012 to 2018 (Fannie Mae, 2019). The Centre for International Climate Research (CICERO), as external reviewer, found the Green Bound framework was in line with the ICMA’s Green Bond Principles (CICERO, 2018). The eligible multifamily properties have to meet one of these criteria: either have a Green Building Certification (recognized in the US); and/or make property improvements which target reductions in energy and/or water use.

Similarly, Freddie Mac’s ‘Green Advantage program’ launched in 2016 has contributed to the securitization of over 33 billion dollars of green loans, for more than 1,100 borrowers (Koontz, 2018). This program focuses on financing energy and water improvements for multifamily properties, within a timeframe of two years. Borrowers have to reduce their energy or water consumption by 30%, including a minimum of 15% through energy improvements (Bloomberg, 2019). In case of failure to fulfil these improvements, it is considered a default on the loan. The US agency communicated on its K-85 deal closed in December 2018 (Koontz, 2018). This K-85 deal was provided for water and/or energy efficient amenities to 26 properties and 7,000 households and more than 30 Investors participated in the deal.

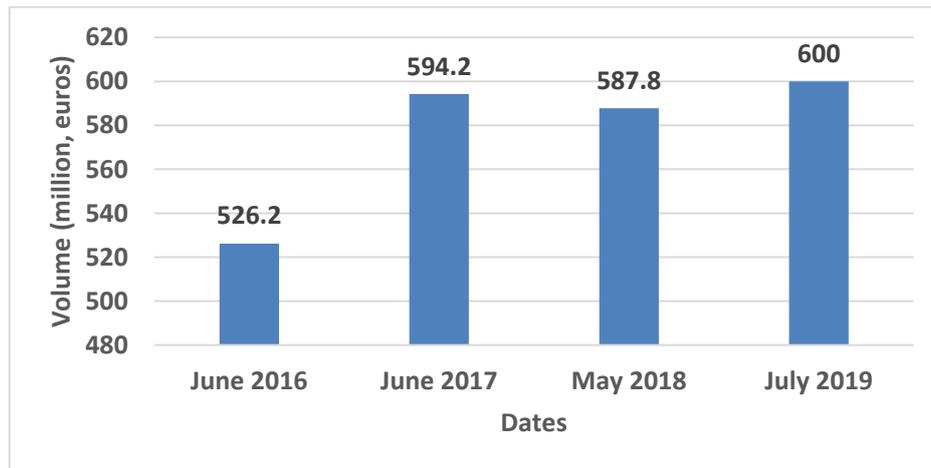
Fig. 2: Freddie Mac K-85 Deal



(Source: own elaboration, data from Freddie Mac website, 2018)

Overall, both Fannie Mae and Freddie Mac incorporated green and sustainable principles into the framework of their government backed Agency MBS.

Synthetic ABS is our second example. In 2017 and 2018, Crédit Agricole (CA) – a large French bank – conducted two significant operations in securitization, which both have objectives of socially responsible investments. Only the first is an example of green capital securitization, using the freed up regulatory capital for new green lending. We examine in more details this operation. CA’s issuance of Green Capital Note was purchased by Mariner Investment Group (an American hedge fund), with an overall transaction volume above 8.2 billion dollars USD in synthetic securitization risk transfer (Crédit Agricole, 2017). Ultimately, the bank committed to redeploy 2 billion dollars USD freed-up regulatory capital in green lending in diverse sectors (as reported by the organisation: ‘renewable energy, energy efficiency loans for commercial real estate renovation, public transportation, and sustainable waste and water treatment facilities’, Crédit Agricole, 2017). This operation demonstrates the high leverage opportunities that synthetic green securitization could have: Mariner Investment Group’s initial investment was predicted to be nearly 150 million dollars, for liberating ultimately 2 billion dollars (Financial Times, 2017). However, the commitment of Crédit Agricole in regularly reporting on this operation and the projects financed may be questioned, as the results are not publicly available to date. Let us now move from synthetic ABS to **Residential Mortgage-Based Security (RMBS)**. Obvion is a Dutch mortgage provider and subsidiary owned by Rabobank. It issued its first 100% green RMBS in Europe in June 2016, which amounted to 526,2 million Euros. Other issuances happened in 2017, 2018 and 2019 in the same – yet growing - order of magnitude (Bak, 2020).

Fig. 3. Obvion's Green Storm RMBS issuances between 2016 and 2019

(Source: Bak/AFME, 2020)

Obvion's Green Storm RMBS transactions are backed by energy-efficient properties and constitutes a good example of a green collateral securitization in Europe. The assets backing the transaction were green residential mortgages linked to energy efficiency homes and the proceeds of the issuance financed those green residential mortgages. Therefore, in these operations, both the securitised assets and the proceeds were green.

The features of the RMBS are very similar in a case of **Commercial Mortgage-Backed Securities (CMBS)** transaction, apart from its application to commercial loans instead of residential mortgages. Goldman Sachs issued the first European green CMBS deal in France (Mooney, 2020). At the global level, the first green CMBS deal was conducted by Natixis for the acquisition of a building in New York City in 2017, for which the issuance amounted to 72 million dollars with a single tranche. In our case, the 'River Green Finance' transaction of Goldman Sachs is a CMBS transaction issued on 6 February 2020, with a maturity date in 2032.² It is a true sale transaction backed by a single loan which is secured with a single property. This transaction is structured with a 196.2-million-euro loan to buy an office in an energy-efficient building in a suburb of Paris (whose name is *River Ouest*, hence the name of the deal). The building has received a certification for its energy efficiency that it must keep while the bonds are outstanding (Mooney, 2020). Precisely, it has received a third-party certification, (BREEAM certification for Building Research Establishment Environmental Assessment Method), with a "very good" certificate in 2017.

In terms of actors and key elements underpinning this transaction, a single-purpose investment fund vehicle has been created with River Green Finance DAC in 2019, structured solely to refinance the acquisition loan. River Green Finance has developed a Green Securitised Bond Framework under which the green mortgaged-backed notes are issued, and, the proceeds are used to refinance the acquisition loan (Sustainalytics, 2019).

² The characteristics of the CMBS transaction are not provided in detail by the issuer, Goldman Sachs, but an aggregation of information from rating agencies and external reviewers, with data made available by Standard & Poor's, Moody's, Sustainalytics, and the Climate Bonds Initiative.

Table 2. Main elements of the River Green Finance Transaction

River Green Finance DAC – 2019		
Asset Class	Amount (million EUR)	Rating
A	103,5	Aaa
B	25,2	Aa3
C	23,6	A2
D	34,09	Baa2
X1		No rating
X2		No rating

(Source: own elaboration, data from Moody’s, 2020)

As the table above indicates, the deal has four rated tranches all with floating rates, plus two Classes X1 and X2 without ratings. The different asset classes were rated by Moody’s on the basis of the real estate quality and characteristics of the collateral, the terms of the loan, and the legal and structural features of the transaction (Moody’s, 2020).

Overall, the rating agency underlined ‘(i) strong lease covenant and occupancy level of the property, (ii) the good quality of the property, and (iii) the moderate initial leverage in combination with scheduled amortisation over the term’ (Moody’s, 2020). There is no mention of the green characteristics of the CMBS transaction as the positive evaluation was provided by external reviewers such as Sustainalytics, actor providing second-party opinions (see Box 1 for more details on the green securitized bond framework in this CMBS transaction).

Sustainalytics took the view that the Green Securitized Bond Framework of the River Green Finance is ‘credible and impactful’. The use of proceeds for green building is aligned with the Green Bond Principles of the International Capital Market Association and its four core components (ICMA, 2018):

1. Use of Proceeds
2. Process for Project Evaluation and Selection
3. Management of Proceeds
4. Reporting

Sustainalytics also reported that the asset backing River Green Finance has also the objective ‘to encourage low carbon transportation among employees through the inclusion of multiple electric charge points and the provision of electric cars’.

Source: Sustainalytics, 2019

The last type of green assets considered in this section concerns **Auto ABS**. Automotive groups are big issuers of securitized assets generally (see for instance groups issuing ABS on Luxembourg Stock Exchange, LuxSE, 2020). Toyota issued a green ABS for low-carbon transport, through Toyota Motor Credit Corporation (TMCC) Green Bond Program. In 2017, these issuances were considered the three largest green ABS (Kidney et al., 2017) amounting to a total of 4,6 billion dollars as of July 2017 (Toyota Financial Services, 2017). These ABS have been secured against existing car leases (standard auto loans) and the proceeds were to be used to finance new leases and loans on the hybrid and electric vehicles only (Climate Bonds Initiative, 2018). The deals hence rely on ‘brown assets’ which free up capital for green assets. In accordance with the above categorisation, these deals do not qualify for green collateral securitization but for green proceeds securitization. Indeed, it is reported that the first green ABS financed the purchase of 39,900 vehicles among eight different car models (Kidney, 2015). It remains to be seen whether the Auto ABS market will further develop with ABS secured strictly with low or zero emission vehicles in the future.

Box 1 The Green Securitized Bond Framework of the CMBS Deal according to Sustainalytics’ Second Party Opinion

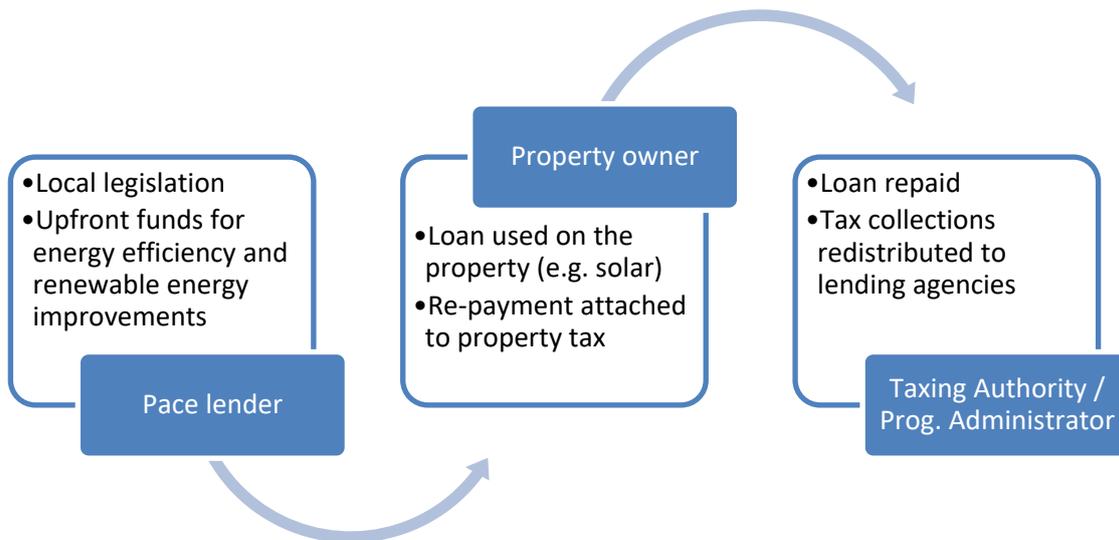
3.2 Two in-depth case studies (PACE and Solar)

In this section we develop two case studies which focus on a ‘Property Assessed Clean Energy’ or PACE mechanisms, and on Solar ABS. These two markets have been developing particularly in the US and in Australia.

- Case Study energy efficiency ABS (PACE)

In the US, a ‘Property Assessed Clean Energy’ or PACE designates a mechanism to finance energy efficiency and renewable energy improvements, as an alternative to traditional credit. This functions as a loan to property owners: the US legislation allows the states to fund the upfront costs invested in energy improvements both for commercial and residential properties. The costs are paid back through property tax bills overtime. The tax bills are redistributed to lending agencies, and this is where the securitization of the loans passes the funding and credit risk to ABS investors. As already explained, the ABS issued will also free up capital for new loans. PACE programmes result in a property tax lien that has priority over existing and future liens on the property, including mortgage (Kully and Tsai, 2020).

Fig. 4. Mechanism of the Property Assessed Clean Energy (PACE)



(Source: own elaboration)

Renovate America is the first incumbent on the market in California since 2008. Renovate America issues green ABS via a special purpose vehicle called HERO³ Funding Trust. HERO finances many types of projects, for instance home energy improvements or water efficiency renovations. For example, HERO 2018-1 transaction of overall 205 million dollars USD was issued in May 2018 and involved levies on 6,979 residential properties (Fest, 2019). This example also shows how credit history helped to improve the credit rating of some notes, taking into account the performance of the deal. Kroll, a ratings agency, upgraded the ratings of some of the notes in this HERO transaction from rating AA to AAA (i.e. for its Class A-2 notes) (Fest, 2019).⁴ It must be said that the company has seen its output in securitizations reduced since 2017.

Fannie Mae and Freddy Mac issue Agency MBS as we have already seen. Both are also active in PACE policies. However, policymakers have recently expressed concerns for the institution safety and soundness due to the potential defaults of homeowners benefiting from PACE programmes. All in all, the concerns are mainly about regulating better PACE lending in US jurisdictions in relation to other mortgages – which do not provide a level playing field.

- Solar ABS

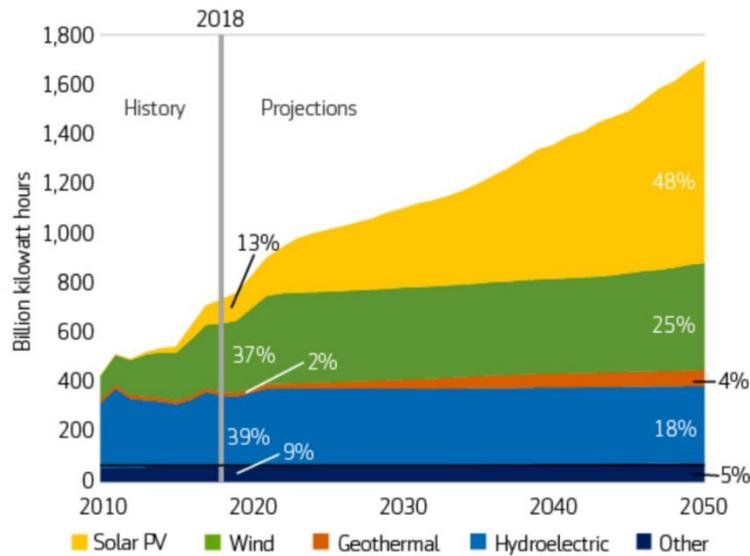
Solar power is a small-scale decentralized energy production technology. The predictability of solar output and hence of project cash flows means that by design solar power lends itself very well to

³ HERO stands for *Home Energy Renovation Opportunity*.

⁴ The amortization rate was improved in comparison with initial projections, because in April 2019, 954 of the original 7,247 PACE assessments were fully paid off.

collateral-based aggregation inherent to securitization. It is also a market with a promising future as the figure below shows, in particular when looking at the long-term downward cost development of the photovoltaic systems.

Fig. 5. Current and projected shares of renewable energy



(Source: US Energy Information Administration – Annual Energy Outlook 2019)

The general functioning of solar ABS can be simply explained along the following lines. Home solar systems (usually in the range of 1 to 4 KW typically) are aggregated into tradable ABS, later trrenched into clear risk classes that help investors unbeknownst to the technicalities of the energy world to be guided through this foreign environment. Most of the deals are backed by power purchase agreements (see the figures below for SolarCity) and lease payments. In 2018, the Solar ABS market in the US reached 2.21 billion dollars USD with seven active issuers. Though, the forward-looking perspective is showing some reduced activity of the solar industry (Podhajsky, 2019). There are different concerns: declining of tax credits in 2020, and their end in 2021, solar import tariffs since 2018.

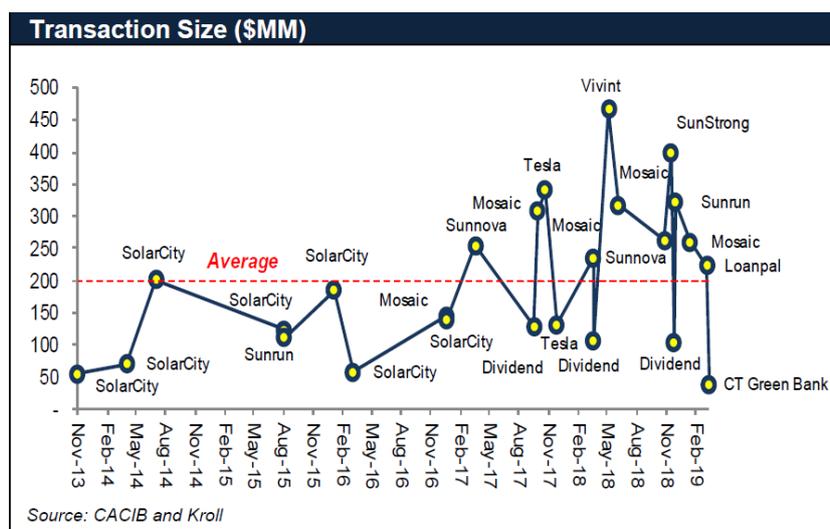
Fig. 6. Securitizations by issuers between 2013 and 2018



(Source: Mendelsohn, 2018)

Solar ABS market has still seen an increase of the number of competitors on the market. Sunrun issued in 2015 its first Solar ABS amounting to 111 million dollars (with Credit Suisse as lead underwriter) (Kidney, 2015). Looking at figure 6, SunPower is a significant incumbent from 2018 (with its issuance called Sunstrong in the figure below). SunPower issued 400 million dollars of ABS (with rating A by Kroll). Sunrun, issued 322 million dollars (rated A-). And, Vivint issued 466 million dollars (rated A-). Recently, Mosaic also took over shares on the market and issued Solar ABS over 3 years with the following amounts, all with a rating A: 446,45 million dollars (overall, with 2 issuances) in 2017, 235,25 million dollars in 2018, and 259,70 million dollars in 2019 (Crédit Agricole, 2019). The below graph shows the transaction size of Solar ABS issuances: it is striking how the average issuance size grew in 2018 (i.e. 315 million dollars, Mendelsohn, 2018), which you can see with 8 ‘peaks’ above this average.

Fig. 7. Solar ABS transactions in Size from November 2013 until February 2019



(Source: Crédit Agricole Project Bond Focus, 2019)

After this general market perspective, case studies focus on specific entities in the US and Australian markets.

First, SolarCity was the first company installing residential solar in the US to issue solar ABS in 2013. SolarCity is a subsidiary of Tesla, acquired through merger in 2016 and now ‘Tesla energy’ encompasses its solar activities. The below table recaps SolarCity’s ABS issuances, encompassing 9 solar ABS deals (data from Crédit Agricole, 2018). The logic is the same as what was already examined, the ABS issuances are backed by power-purchase agreements from SolarCity’s customers who installed residential Photovoltaic installations. What is important to keep in mind is that the green ABS issuances were private placement offerings (Kidney et al., 2017). But the current situation of SolarCity is at risk due to business and governance choices made since its merger into Tesla, contested in Courts by SolarCity’s shareholders (Kolodny, 2019, Financial Times, 2020).

Table 3. Solar ABS issued by SolarCity between November 2013 and December 2017

Date of issuance	Value (million USD)	Ratings	Credit Rating Agency
November 2013	54.4	BBB+	S&P
April 2014	70.2	BBB+	S&P
July 2014	201.5	BBB+	S&P
August 2015	123,50	A	Kroll
January 2016	185	BBB / BBB	S&P / Kroll
March 2016	57,45	BBB / BBB+	S&P / Kroll
January 2017	145	A-	Kroll
March 2017	340	A-	Kroll
December 2017	130,92	A-	Kroll

(Source: own elaboration, data from *Crédit Agricole Project Bond Focus*, 2018)

In the Australian and New Zealand market, FlexiGroup Ltd issued green tranches in its ABS with certification from the Climate Bonds Standard Board. It is the first Australian company to issue green ABS to finance solar receivables, i.e. residential solar PV systems, energy storage systems and control systems plus solar hot water systems. These solar receivables are part of portfolios of consumer receivables (FlexiGroup, 2018). Between 2016 and November 2019, FlexiGroup issued 4 solar ABS, whose key data are summarised in a table below.

Table 4. FlexiGroup’s Solar ABS

	Date of issue	Size (US\$ million)
Flexi ABS Trust 2016-1	April 2016	39
Flexi ABS Trust 2018-1	May 2018	61.7
Flexi ABS Trust 2019-1	March 2019	65
Flexi ABS Trust 2019-2	November 2019	70

(Source: own elaboration, data adapted from *Climate Bonds Initiative website*).

4. Benefits, Costs, Risks and Limitations of Green securitization

Green securitization has several potential benefits, but it also faces costs, as well as risks and limitations. By turning illiquid assets into liquid assets, green securitization brings obvious market depth benefits. At the same time and as previous examples illustrated, green securitization is also a complex and costly process.

4.1 Market-level and bank-level benefits

Market-level and bank-level benefits can be distinguished. First, at the market level, green securitization aggregates micro projects into instruments of a critical size to qualify for acquisition by institutional investors who are constantly on the search for green finance opportunities. On the buying side, several

actors such as pension funds, insurance companies, asset managers and retail investors may be attracted by the yield return, the liquidity, and, generally the terms of green securities (Kidney et al. 2017). On the selling side, securitization provides access to debt markets to small-scale actors previously excluded from them. Overall, this market widening both improves the access to capital and, potentially, lowers the cost of capital, in particular when comparing to usual bank financing (Kidney et al. 2017). And yet, it must be stressed that the lack of rating history is usually driving the cost of green ABS up.

At the level of banks, green securitization frees up capital for new projects including green projects thus increasing the banks' lending capacity. Secondly, green securitization diversifies bank's funding sources, which also ensures a larger distribution of risks.

4.2 Costs

However, there are costs of different nature involved in green securitization. There is first a transactional cost. A typical bank would not carry out such a transaction on its own, it will need to team up with experts in the field as trustees or dealers. Moreover, there are legal and compliance costs. Indeed, securitization requires elaborating a prospectus for a securitized asset, which is no easy task. It becomes even more complex when the issuer seeks to be compliant with green principles and standards.

There is a third-party review cost, with a few reviewers active and credible on the market (as we will see below). In order to ensure that green features of the assets are guaranteed, a third-party reviewer and possibly external consultants give some certifications of compliance with some standards and/or principles. Moreover, on the public sector side, it is still necessary to ensure that public authority certification is properly implemented and that the data sourced from such public authority certifications are included in the databases of originators in order to be able to model the pool (this concerns in particular the asset selection for the pooling and accountability to the bond holders purchasing the ABS bonds of a green securitisation). Finally, there is an aggregation cost: how to ensure that the loans inserted in the pool of assets have similar features?

All the above costs, either in time or as to the resources mobilised, greatly explain why only actors of a certain size can rely on green securitization as a technique.

4.3 Risks

Green securitization also carries a few risks. The first is the uncertainty on the greenness of securitization: how green is green securitization? To answer this question, green securitization generally includes the categories of securitization explained above, that is green collateral, green proceeds and green capital securitisation (James and Parker, 2019). In the second and third type, the proceeds/capital relief may still be backed by a pool of non-green assets. In other words, the green proceeds securitization and the green capital securitization are not dependent upon the origination of green assets. This led some to advocate that only 'green collateral securitization' deserves to be called green securitization and that the rest is at risk to constitute green-washing.

Another risk, particularly associated to green proceeds securitization, is carbon lock-in. Carbon lock-in can occur in the event that green investments are backed by brown assets (Barnes, 2019). Barnes refers to two examples in which the portfolios of assets backing the arguably green security included oil and gas and aviation assets, and this is also the case mentioned with Toyota (i.e. Toyota Motor Credit Corporation Green Bond Program issued three green ABS for 4.6 billion euros in 2017).

Overall, one cannot (and should not) assume that the freed-up capital on bank balance's sheet will actually be allocated to green projects, this is at the discretion of the 'green issuer', and upon its public communication and reporting on the fulfilling of prior commitments. (i.e. Crédit Agricole synthetic green ABS with US Hedge Fund Mariner Investment Group see above).

4.4 A big limitation: the lack of a single definition

As the examination of the categorisation and scope of green securitization showed beforehand, we lack a clear definition of what a green asset is. There is no agreed definition of green assets, green bonds and of green securitization, and rather competing definitions. For now, different organisations and institutions have proposed diverse criteria. Further criteria concern the underlying definition of green bonds and could also help classify and define green securitization (James and Parker, 2019). Among others, the part or full (re)financing of green projects and, the criteria for other underlying asset classes than bonds (Green mortgages, auto loans, commercial lending) must be considered.

Only a transversal approach in these underlying elements of securitization, also called ‘qualifying assets’, allows one to define holistically what could be green securitization. That is why a ‘single accreditation standard’ (Kidney et al. 2017) for green assets is considered necessary first at the regional level, the EU for instance, and in the medium term, globally. It must be acknowledged that with the EU Taxonomy (Technical Expert Group, 2020), there is a first step in the good direction, and the EU Green Bond Standard would also help to level the playing field, though on a ‘voluntarily’ basis.

Table 5. Overview of actors and related principles or standards for assessing green securities

Actor	Frameworks for standards, principles or criteria
Climate Bonds Initiative	Climate Bonds Standard & Certification Scheme
International Capital Market Association (ICMA)	Green Bond Principles Social Bond Principles Sustainability Bond Guidelines
China	China’s Green Bond Taxonomy
ASEAN	ASEAN Green Bond Standards
European Union Initiatives (ongoing)	2020 – EU Taxonomy 2020 – usability guide, draft EU Green Bond Standard (Technical Expert Group)
Selected Rating Agencies	Standard & Poor’s Green Evaluation Moody’s a Green Bond Assessment Fitch an integrated ESG scoring system

(Source: adapted from James and Parker, 2019 and IOSCO, 2020)

Which definition would fulfil market expectations without interfering with the development of business opportunities? The definition needs to be clear but also flexible and broad enough to apply to a wide range of deals, capturing several underlying assets fulfilling the criteria. Ultimately, two concerns must be reconciled: the need for an operational definition with clear criteria on the one hand, (a too wide definition would not be practical for the industry) and the market should be wide enough to leverage on investment, on the other hand.

The identification of green assets within existing asset classes such as mortgages and auto loans is relatively simple. Standards such as the Climate Bonds Standard and Certification scheme’s criteria for low-carbon buildings and other asset classes already exist in order to identify green asset pools (see an overview of principles and standards in the above Table). Where things are more complicated is for new asset classes – such as energy efficiency products and renewable energy. It is there in particular that, for instance, there is a lack of standardisation at the origination of the loan contracts.

The lack of clear and recognised standards and a common risk assessment methodology makes external party reviews even more important. External party review actors assess the green features of the portfolio in the securitization and how the proceeds are allocated. The review is also important in

the existing loan books: portfolios of mortgages from the banks which are audited to identify green assets already held (Kidney et al., 2017).

5. Incentives that could support green securitization

Various policy measures could support the development of a green securitization market in Europe. We start with transparency and supervisory measures (a), we then look at market development measures that development banks could provide (b). Lastly, we consider the potential role that central banks could play in this supporting process (c).

5.1 Transparency and supervisory measures

The lack of a common and recognised definition or standard of what green assets are is hampering and will hamper the development of green securitization. The very first incentive that can support green securitization further is transparency. In that regard, clear roles and responsibilities should be assigned in order to enforce green disclosure, reporting and monitoring of those exercises.

Article 22(4) of the Securitization Regulation provides for publication of some information in very specific circumstances. Indeed, in the presence of underlying exposures to residential loans/car loans or leases, and only these specific assets, the available information related to the environmental performance of the financed assets should be published. This is an example of existing environmental disclosures, which may be extended to more assets by the European Commission in 2021 (Bak, 2020).

To ensure the greenness of securitization, all stakeholders should trust a credible – market-led or policy-led - monitoring of the underlying loan pool and allocation of proceedings. Without unanimous trust in the market place it is doubtful how such a market will develop durably and how green loans will be identifiable and eligible for integration into portfolios. And this monitoring should either be placed under specific supervision (in the same way that Credit Ratings Agencies are supervised), or, accredited by public authorities for their operations.

A related aspect is the need to have credible green ratings. Currently, green securitization is perceived by market players as riskier because of the lack of credit rating history, without available data on default rates and loss given default, for instance for new asset classes (solar PV, energy efficiency loans), the market is facing an unknown asset performance (Kidney et al., 2017). De facto, this means that very often the securities do not reach the AAA/AA/BBB tranches preferred by institutional investors, at least not in their first issuances.

Without going into technical details, different measures could help making lending to green assets more attractive. One can think here of preferential green lending rates or tax incentives. Positive measures might include adjusted capital requirements for green loans. For instance, risk weighting could be adjusted, i.e. taking into account environmental factors in the capital weights, or more generally a green supporting factor (Kidney et al., 2017). In the same rationale, a supporting factor exists for SMEs in the Capital Requirements Regulation to increase lending to SMEs, see Recital 44, and Article 501 of the CRR II which provides for ‘Capital requirements deduction for credit risk on exposures to SMEs’. With high capital ratios stemming from prudential regulation post financial crisis, banks have reduced their lending to long-term low-carbon projects also associated with a higher degree of risk than the other high-carbon counterparts (Kidney et al., 2017). Going forward, at the policy level, would it be conceivable to do a step ahead through prudential regulation? This would mean choosing and balancing the types of risk exposures in accordance with other broader concerns of the legislators. One should note here that the latest Capital Requirements Directive V review included environmental, social and governance (ESG) risks. Another question open for discussion and further reflection is the leeway for incentives through supervision. Could and should risk-weighting of capital follow environmental factors to encourage a capital reallocation? In this approach, the supervisors would take into account environmental risks as part of the inclusion of ESG risks in the review and evaluation performed by

supervisory authority (an EBA Report is expected by June 2021, as per Article 98 (8) CRD V, and guidelines may follow on the uniform inclusion of ESG risks in the Supervisory Review and Evaluation Process, so called SREP).

5.2 The lack of harmonized contractual provisions of green loans

The absence of harmonized contractual provisions of green loans is a problem. The argument is simple: in a state of affairs in which each contract has a different structure, the transactions costs to assess their financial performance is very high for structurers, rating agencies and investors. Yet, as reported by Kidney et al. (2017) the construction of renewable projects can rely on such standardized contracts (e.g. the use of FIDIC contracts).⁵ Such standardized contracts could be used and further developed in power purchase agreements, as well as for loan contracts in solar installations and energy efficiency upgrades (Kidney et al., 2017).

A way forward could thus be to standardise the financial elements of a green securitization in order to reap economies of scale when aggregating them. Following the proposals in the field (Kidney et al., 2017), this could be achieved by standardising the structure of loan contracts or of power purchase agreements for solar photo-voltaic based power production. The US Department of Energy has launched a promising initiative that goes in this direction, called the Solar Access to Public Capital initiative (US Office of Energy efficiency and renewable energy, 2020).

The European Union's Capital Markets Union offers plenty of potential to ensure harmonisation of asset-backed securities as well as loans.

5.3 Market development measures by development banks

Public actors – and in particular development banks at international, national or regional level – often played an active role in order to accompany the development of securitization in new asset classes. One may think for example of the key role played by the European Investment Bank (EIB) and the European Investment Fund in the creation of an SMEs' securitization market. Or one may think of the securitization of student loans in the US.

Those actors could play a similar role for green securitization, thus ensuring that public resources – which given the coronavirus crisis will be even tighter in the future - are leveraged to unlock private sector market development in green finance.

Development banks are institutional actors that can foster the involvement of the private sector in international development finance. They started being interested in securitization after the G20 called several times MDBs to optimize their balance sheets (see for instance, G20, 2015). In particular, these MDBs could enhance the securitization of sustainable projects (Gabor, 2019). Securitization has in this regard become central to the ambitions attached in sustainability and development goals (SDG, United Nations, 2015). This finance development enhancement would have diverse advantages, in particular in emerging economies. For example, in Rwanda where an instrument is being developed by the Development Bank of Rwanda and Access to Finance Rwanda. In 2019 a first issuance of a solar ABS at 9 million USD, developing solar systems for about 175 000 households. The project leaders claim however that 'at scale Solar Securitization for Rwanda' can reach US\$ 100 million in size in Rwanda alone, expanding energy access to 2 million households. Green or sustainable securitization could boost the attractiveness of capital markets in emerging countries, reduce their reliance on external debt, and, foster resilience to countercyclical events (Gabor, 2019).

Also, at the sub-national level, green development banks have flourished. Two recent examples in the US and in Australia illustrate this activity (Wapner et al., 2019). In the US, NY Green Bank (NYGB)

⁵ Types of contracts put forward by the International Federation of Consulting Engineers, based in Geneva – FIDIC is the French acronym also kept in English, *Fédération Internationale Des Ingénieurs-Conseils*.

has supported a transaction of a solar energy actor, Solar Mosaic (one of the actors seen in the overview of the market for Solar ABS outlined in section 3). It provides homeowners with loans for installing solar systems. In 2016, NYGB committed to a senior secured credit facility which financed residential solar systems in the state of New York (Wapner et al., 2019). Mosaic refinanced and repaid the facilities received from NYGB. More recently, in the fourth quarter of 2019, NYGB registered 117,5 million dollars USD of clean energy investments (Renewables Now, 2020).

In Australia, clean energy projects were supported by the Clean Energy Finance Corporation (CEFC), using an aggregation approach. The aggregation partnerships were concluded with Australian commercial banks and worked through ‘credit intermediated structure’ (Wapner et al., 2019). The chain is quite simple: the CEFC offers debt say to Westpac (an Australian commercial bank), who in turn offers to its customers asset financing clean energy, building energy efficiency etc. One important point is that the risk taken by CEFC is on the intermediary and not the underlying assets. This ends with discounted interest rates or longer loan tenors for the customers. Overall, CEFC targets smaller projects, and, reportedly, over 5,500 of such projects benefited from aggregation partnerships (Green Bank Network, 2017). Moreover, securitization helped CEFC to mobilize large-scale investors for financing clean energy projects. Overall, in its support to green securitization, CEFC imposes requirements on the use of proceeds, while limiting its exposure to the credit performance of the assets backing the securities (Wapner et al., 2019).

Box 2. Overview of selected development Banks’ support for green securitization in Rwanda, the US and Australia

 Rwanda	 USA	 Australia
Development Bank of Rwanda and Access to Finance Rwanda (2019) <ul style="list-style-type: none"> • Solar ABS • \$ 9 million • 175,000 households <i>Potential:</i> <ul style="list-style-type: none"> • \$ 100 million • 2 million households 	<ul style="list-style-type: none"> • NY Green Bank (2016) • transaction of Solar Mosaic • residential solar systems installation • Mosaic refinanced and repaid NYGB facilities <i>4Q 2019:</i> <ul style="list-style-type: none"> • NYGB registered \$ 117,5 million clean energy investments 	<ul style="list-style-type: none"> • Clean Energy Finance Corporation (CEFC) • through aggregation, with Australian commercial banks • Credit intermediated structure and targets smaller projects • 2016/17: FlexiGroup’s securitisation • Benefited to > 5,500 projects

(Source: own elaboration)

Generally, development banks at all levels could do three things. First, they could act as market-maker by providing cornerstone investment: in order to ensure an initial flow of green ABS, for instance the EIB, the EBRD and national development banks can commit to investing in initial green ABS deals (Kidney et al., 2017).

Secondly, they could provide credit enhancement through guarantees of given tranches. This would be in line with the de-risking role of Multilateral Development Banks/Green Banks. They would lead the way and encourage institutional investors to follow and invest in green ABS. Along the lines of SME securitization credit enhancement that already happens in the EU, the EIB/EIF could provide guarantees for the junior and possibly mezzanine tranches of green ABS to ensure that the senior tranches become more attractive to institutional investors.

Thirdly, development banks could facilitate the matching process by acting as data or loan warehouses in order to address the market failure of information asymmetry, possibly in public-private agreements. What are loan warehouses? They are structures that aggregate loans together across different and varying loan originators. The reasoning is that for green securitization, more often than not, actors are not big enough to reach aggregated packages of loans of a critical size. There is therefore a market failure to address. A less ambitious but still effective market facilitation measure would consist in creating a single European green data loans warehouse that centralizes all available information on green loans and would therefore facilitate the matching process.

This system has been already used in the US with a Warehouse for Energy Efficiency Loans (WHEEL) established through a public-private partnership in 2014 in Pennsylvania (Kidney et al., 2017). In the EU, as proposed by Kidney et al., the EIB could sponsor a green financial warehouse or lead such an initiative in cooperation with the private sector.

5.3 Market development measures by central banks

Some suggest including larger shares of green ABS into asset purchase programmes of central banks. In the EU for example, the European Central Bank (ECB) could purchase green securities in its different asset purchase programmes. The ECB is the EU's largest buyer of green ABS as of now (Kidney et al., 2017).

Is there room to develop specific green quantitative easing programmes? What can be seen is that central bank leaders, such as Christine Lagarde (ECB, 2020)⁶ and Mark Carney (Bank of England),⁷ forcefully pointed at the risks climate change poses for the financial sector, the necessity to better understand its impact, and to think further how to insert sustainability considerations in monetary policy frameworks. These reflections are now actively supported by international fora involvement and other central banks (Bolton et al., 2020 and Network for Greening the Financial System, 2019).

6. Conclusions

As we have explained in this paper, green securitization – which captures a diversity of techniques using various eligible assets – is a relevant tool to tap into the depth of the bond market in order to finance green investments. However, a necessary condition is that underlying assets have been issued in sufficient quantity: there is the need for a sufficiently large pipeline of green assets in the first place to ensure the deals offer liquidity in a market, especially in the case of green collateralized securitization, i.e. green asset-backed securities. Indeed green ABS are really green if they come under the umbrella of green collateral securitization. As we have seen, green proceeds securitization and green capital securitization may still be only partially 'green' transactions since brown assets could still back the issuance of the securities.

Green securitization belongs to the techniques that could contribute to increasing the depth of green bond markets thus helping to match a growing investment appetite among institutional investors. The market is currently growing but remains small in size, when one remembers that, for instance, green ABS constitute 2 to 3% of the global ABS market. In the US it has grown significantly in past years, also through the involvement of public mortgage agencies like Fannie Mae and Freddie Mac. In the examples examined, we observed growing green issuances in Europe. Comparing the types of issuances and their features across continents will certainly become increasingly important to get a sense of the

⁶ ECB's President highlighted three categories of risks: disregard, delay and deficiency.

⁷ The Bank of England has a Task Force on Climate-related Financial Disclosures (TCFD) and its governor said 'In short, every financial decision must take climate change into account' taking into account three risks in reporting, risk management and returns.

value of those green securitization deals. This requires more evidence communicated publicly, for example on third party assessments of the green nature of the deals.

A key barrier to the development of green securitisation is the absence of standardized definition, common risk assessment methodology, common cash flow models and of standardized green loan contracts. They would allow for a simpler aggregation and would reduce the current high transaction costs. Regulatory initiatives on defining what green and non-green assets are – such as the EU taxonomy for sustainable finance – will definitely help the market to develop.

As regards the future of market size of green securitization it largely depends both on market and political forces and is therefore by definition uncertain. But the following questions should help better understand the sustainability of its drivers. They are also investigated by the Commission in a public consultation on ‘Renewed sustainable finance strategy’ that would drive the upcoming recovery (European Commission, 2020).

- What will be the role of banks and non-banks actors in financing the energy transition?
- Which role for aggregation? And which actors and technologies (e.g. blockchain) will support this process?
- Will green securitization lock-in brown assets and slow down the transition to a low carbon economy or will it reduce the cost of the energy transition for incumbents and hence transition risks? Is brown asset backed securitization: a risk or an opportunity?

Being based on already performed primary investments, green securitization will no doubt profit from larger volumes in green investments (e.g. energy efficient house refurbishments, solar panel installations, etc) which governments throughout the world have started to implement over the last two decades and which are likely to be enhanced over the years to come. In the EU, the Commission’s newly proposed New Green Deal appears indeed to be a game changer in terms of order of magnitude of investments to be supported. The Commission itself expects the Sustainable Europe Investment Plan to mobilize up to 1 trillion euros of private and public sustainable investment over the coming decade. As the Commission stressed it time and again, public action will need to be complemented by private action as private funding will be providing scale here. (European Commission, 2019). This is all the more true further to the corona virus crisis. In a world in which man-made climate change risks and its consequences on our daily lives is becoming clear to all of us, green securitization – while not the only solution – is likely to be one of the answers.

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