

The Green Bond



Christopher R. Kaminker, PhD
Head of Research, Climate & Sustainable Finance; Senior Advisor, Large Corporates & Financial Institutions
[SEB Green Bonds Website](#)

SPECIAL EDITION: World Water Week

Executive Summary

The green bond market shifted back into a more traditional summer lull, from its jagged pattern of issuance and growth in 2Q18 which had delivered its second highest quarterly figure to date of **USD 49 bn**. As predicted, issuance reverted to 2016 era levels, with July falling to USD 7.9 bn (-34% YoY) and August achieving only USD 4.7 bn (-49% YoY) with one week remaining but featuring some bright spots of activity from Municipals and Financials.

However, this modest summer outcome only slightly moderated 2018 growth, boosted by a **1H18 figure of USD 85 bn**; up 21% YoY with at least 85 issuers active in 16 currencies setting a 1H period record. As such, the whole market was up by 19% YoY with **USD 97 bn** YTD and total cumulative green bond issuance hovering just below the USD 500 bn mark.

The summer slowdown is more a function of **global bond market conditions** than any specific to green finance. European bond deals from July 1 - August 8 were at their lowest levels in 13 years and the U.S. corporate bond market saw its quietest July in at least 5 years.

Despite this, our view remains that **positive prospects are plentiful** for the rest of the year, with the market continuing its fruitful quest of sectoral maturation and diversification with 24 repeat issuers in 1H18 and large economies featuring heightened activity alongside new sectors. A prominent pipeline of deals remained for 3Q, or later (see [Section 2](#)). Our 2018 base-case issuance scenario is held at **USD 185 bn**.

Agencies are on watch for a **downgrade**, falling further away from their potential almost every month (with issuance levels -50% YoY). However, due to solid growth we **upgrade** the potential for **Sovereigns (USD 17 bn)** and **Suprationals (USD 14 bn)**.

Corporates have been particularly buoyant with **USD 44 bn** up 40% YoY. **Financials** have been the dynamo behind this with **USD 27 bn**, **double** last year's contribution, and look to be on track to exceed our estimate. **Green securitizations** are nicely on track with our scenario for 2018 with USD 14 bn. After a decent 1H, non-financial corporates reversed to -8% YoY; well below potential.

Geographic activity is widespread; with **34 jurisdictions** featuring green bonds YTD. The center of gravity for the market pulled back somewhat on its shift towards **Europe** in 2018. This shift has been driven by European corporates and sovereigns and has been underway alongside increasing policy attention from the European Commission.

In honor of Stockholm World Water Week, SEB releases [new analysis](#) into how green bonds are channeling financing for water investments. The results of the analysis indicate that at least USD 100 bn (or ~20%) worth of green bonds from 103 individual issuers have included "sustainable water & wastewater management" as one of their use of proceeds.

SEB Climate & Sustainable Finance Review

Guest contributors welcomed in this edition:

SEB's [Marie Baumgarts](#) on the state of play of the European Commission Technical Expert Group on Sustainable Finance;

[City of Gothenburg](#), the first municipal issuer reflecting on their 5 year green bond anniversary;

[Nick Robins \(London School of Economics\)](#) on new frontiers in sustainable finance.

[CICERO](#): Scientific update after a long hot summer.

Letter to the Reader

"After a summer with headlines such as "Iceland having its worst summer in 100 years" and "Hottest July in (at least) 260 years for Sweden", we are all wondering what is going on.

As a consequence we have asked Knut Alfsen at CICERO to contribute a piece on the climate in this edition."

(Continues, pg. 2)

Christopher Flensburg
Head of Climate & Sustainable Finance, SEB



Letter to the Reader (full text):

After a summer with headlines such as “*Iceland having its worst summer in 100 years*” – caused from melting of ice from the North and “*Hottest July in (at least) 260 years for Sweden*”, we are all wondering what is going on.

As a consequence we have asked Knut Alfsen at CICERO to contribute a piece on the climate in this edition. It's well worth reading but doesn't provide much comfort.

Over the last 5 years the municipality sector has been a key driver of Green Bond issuance and in connection to its 5 year Green Bond anniversary, the City of Gothenburg shares their inside perspective from being the 1st municipal Green Bond issuer and how this has impacted their work and strategies.

We have also given space to a more philosophical article from Nick Robins at the London School of Economics, where he draws on his recent experience from co-heading the UN Inquiry into the Design of Sustainable Financial System to share his thoughts on what's at stake and what it takes to get results.

All in all – this is a publication which taps into the mind of leaders and gives them a window to share their current state of views – alongside (obviously) an update on the market; this time with a special focus on water to highlight World Water Week taking place at the moment here in Stockholm.

Enjoy your reading,

Christopher Flensburg

Head of Climate & Sustainable Finance, SEB



1. Green Bond Market Review and 2018 Outlook

The green bond market shifted back into a more traditional summer lull, from its jagged pattern of issuance and growth in the second quarter of 2018 (2Q18) which had delivered its second highest quarterly figure to date of **USD 49 billion**, up 26% Year-over-Year (YoY). As predicted in the previous edition and visualized in Figure 2, the summer was very slow compared to last year. Issuance reverted to 2016 era levels, with July falling to USD 7.9 billion (-34% YoY) and August achieving only USD 4.7 billion (-49% YoY) with one week remaining but featuring some bright spots of activity from Municipals and Financials (see discussion below).

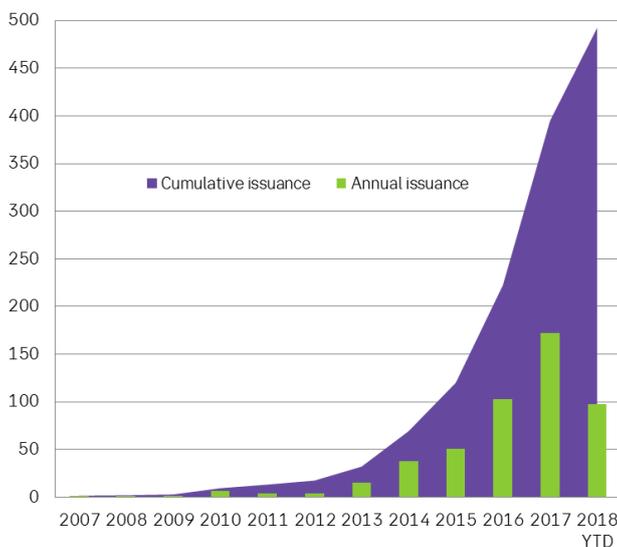
Christopher R. Kaminker, PhD
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However, this modest summer outcome only slightly moderated 2018 growth, boosted by a **1H18 figure of USD 85 billion**; up 21% YoY from at least 85 issuers active in 16 currencies working to set a 1H period record for this nearly decade-old market.¹ As such, as August was ending, the whole market was up by 19% YoY, with **USD 97 billion** of cumulative issuance YTD and total cumulative green bond issuance hovering just below the USD 500 billion mark (Figure 1) and a prominent pipeline of announced deals remaining for 3Q, or later in 2018 (see [Section 2](#)).

As shown in Figure 2, the robust 2Q ending was largely attributable to outstanding results in April and June. On the back of more supportive market conditions, April issuance exceeded last year's levels by 49% ending with USD 14.5 billion. Even though May was down slightly YoY on total issuance volume of USD 13 billion, the month saw the highest number of issuers Year-to-Date (YTD)², with 55 individual entities foraying into the green bond market.

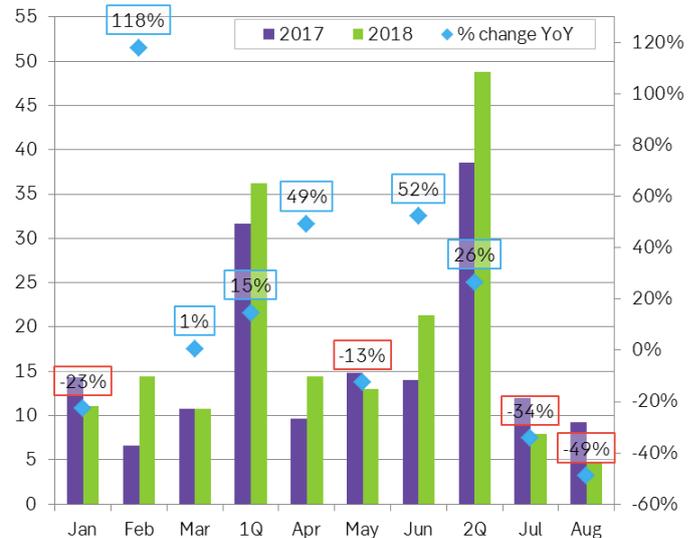
We revised our June figures up even higher to USD 21.3 billion; from 41 issuers in 15 jurisdictions, split encouragingly evenly between new and repeat issuers. A syndicated EUR 4 billion tap of the French Green sovereign OAT, and energetic contributions from financials (up 230% YoY) and securitizations (up 90% YoY) boosted the monthly totals by 52% over the previous year.

Figure 1. Total Cumulative Issuance (USD Bn)



Source: SEB analysis based on Bloomberg and SEB data

Figure 2. Periodic issuance (USD Bn) and % change YoY



Source: SEB analysis based on Bloomberg and SEB data

As broached in the last edition, the slowdown in July and August, along with the decreasing growth rate overall for the green bond market (from its nearly exponential last few years) has its roots intertwined in a number of dynamics, most of which are not specific to green finance. The overall bond market has slowed in 2018 and fickle market conditions and downside scares have held back bond issuance globally, throughout July and extending halfway into August.

According to Dealogic figures, global bond markets were initially encouraged by one of the strongest first quarters on record (USD 1.95 trillion of volume issued in 1Q18), started to drop off in 2Q18 to USD 1.68 trillion (with 5,110 transactions); the lowest second-quarter volume in

¹ SEB's revised 2017 year-end figure has not changed since the last edition, and matches BNEF/Bloomberg figures.

² Henceforth, YTD will refer to the period of 1 January 2018 – 27 July 2018

the past 3 years, and lowest 2Q number of deals in the past six years. Bond activity continues to be affected by news of interest rate hikes and market reaction to the current political environment. The value of deals conducted across Europe's debt capital markets between July 1 and August 8 totaled USD 127.4 billion; the lowest figure for 13 years. The drought extended to the equity capital markets with only USD 9.2 billion raised over the same period in Europe according to Dealogic — the lowest amount since 1995. Across the Atlantic, the market for US corporate bond issuance saw its quietest July in at least five years.

SEB's Nordic Outlook released in August indicated that exports, capital spending and industrial production will continue to be hampered by future uncertainty about trade war and Brexit, although these effects are difficult to measure. The crisis in Turkey clearly had an impact on volatility and contributed to market malaise over the summer. In the final week of August investors were watching the US Treasury yield curve, the risk of a no-deal Brexit for the UK and the pressure on Italian banks. All these signals, mixed with instability in other emerging markets, raise questions pointing to the end of the current credit cycle.

As discussed below, growth prospects for the green bond market in 2018 can also be expected to be balanced by issuers and investors considering opportunities to raise capital via new and growing **social and sustainability bond** financing channels. This trend has been visible in the market since the elaboration of the Green and Social Bond Principles in 2017 and while a very positive development has also drawing been down on green projects that might previously have been funded via the green bond route (especially in the case of sustainability bonds).

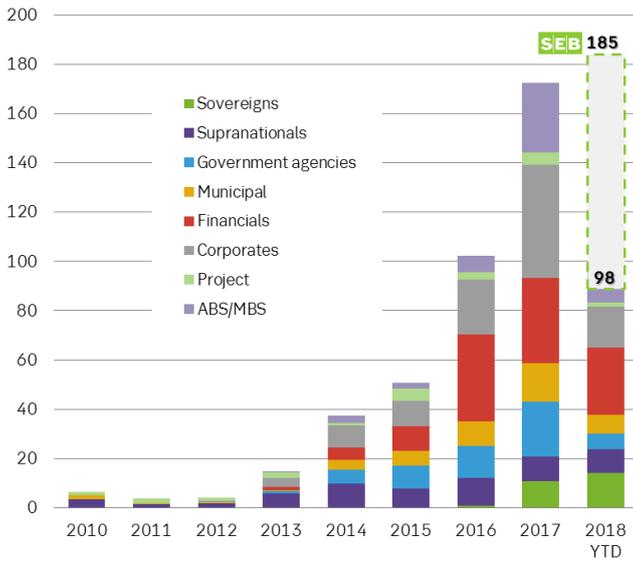
Social bond issuance in 2Q18 came to USD 2.4 billion in 6 currencies resulting in a H1 2018 total of USD 4.7 billion taking the cumulative amount outstanding to USD 15 billion. Sustainability bonds were also plentiful in 1H18, with 2Q18 seeing USD 2.6 billion issued in 3 currencies, taking the YTD volume to USD 7.5 billion, up from USD 5 billion YoY; and the cumulative outstanding amount to USD 29 billion.

It is also worthwhile reiterating two methodological notes here. First, as described previously it takes some time for the full volume of green bonds issued to be catalogued (including Chinese, securitizations, project bonds, and other private placements).³ Second, SEB uses the “deal effective date” listed on Bloomberg to determine month of transaction to reflect a more accurate picture of the market dynamics and momentum around the day of the actual trade (as opposed to dates of announcements or settlements). This is important in a relatively small market where a single large issue (such as the aforementioned syndicated OAT June 26 tap – which settled in July) can sway the monthly figures significantly.

Despite all of this, our view remains that positive augurs are plentiful for the rest of the year, with the market continuing its fruitful quest of sectoral maturation and diversification (compare Figures 3 and 4); with over two dozen repeat issuers coming to market in 1H18; some large economies featuring heightened activity (e.g. the US corporate market, Spain, Germany, Japan, and Indonesia) alongside new sectors (e.g. shipping and pension funds). The Swedish and Japanese green bond markets already started to pick up towards mid-August, and the market looks to have had a chance to reassess pricing and take stock of macro risks before returning with a clear backlog of trades this autumn.

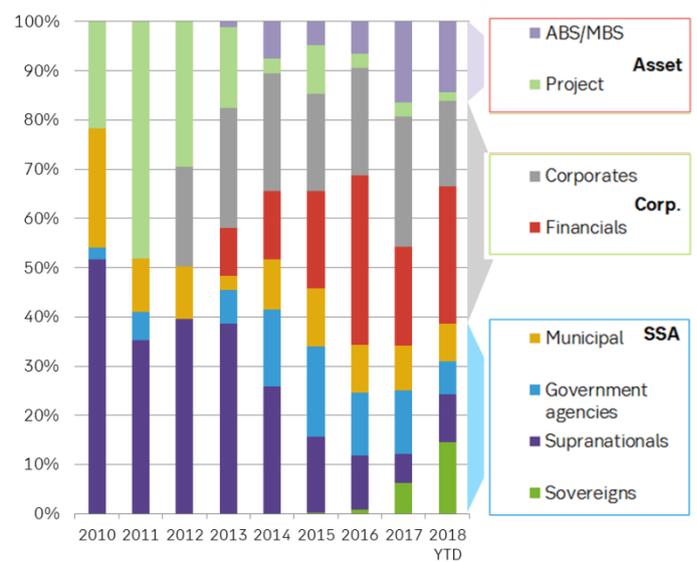
³ SEB uses Bloomberg (BNEF) data which includes self-labelled green bonds as well as those tagged by Bloomberg as green bonds. For methodologies used to qualify green bonds see Bloomberg (2018) *Guide to Green Bonds on the Bloomberg Terminal*. Asset-level bonds, schuldscheine and private placements are included and pure plays are excluded. The data are supplemented by SEB from other sources to provide a more current assessment of issuance, since there is a lag for some green bonds being uploaded to the Bloomberg Terminal.

Figure 3. Green bond market growth (USD Bn) by sector



Source: SEB analysis based on Bloomberg and SEB data. SSA: Sovereign, sub-sovereign (municipal/regional), Supranational and Agency.

Figure 4. Sectoral evolution (% share of annual issuance)



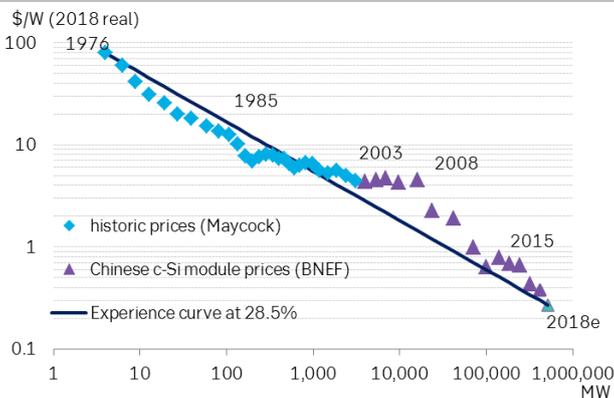
Source: SEB analysis based on Bloomberg and SEB data

A powerful constitution of underlying green infrastructure investment dynamics on both risk and opportunity sides of the equation as well as new policy attention stands ready to continue to support the momentum from 2017 and bolster green bond issuance in 2018 as issuers across sectors find green projects on their balance sheets. As of 1H18, renewable energy continued to be the largest use of proceeds allocation for reporting issuers at 48%, followed by green buildings and sustainable transportation at 26% and 14%, respectively.

As just one example of the dynamics in the clean energy space, a mixed picture in 2018 is emerging, with dollar investment in solar under pressure while commitments to wind power, electric vehicles and batteries are running above 2017 levels. The slippage in solar reflects two main developments – significantly lower capital costs for photovoltaic (PV) projects (see Figure 5), and therefore fewer dollars spent per megawatt installed; and a cooling-off in China’s solar boom. According to BNEF, reflecting this dynamic, global investment in clean energy stood at USD 138 billion in 1H18, down just 1% YoY but 2Q18 saw a rise to +8% YoY to USD 77 billion.

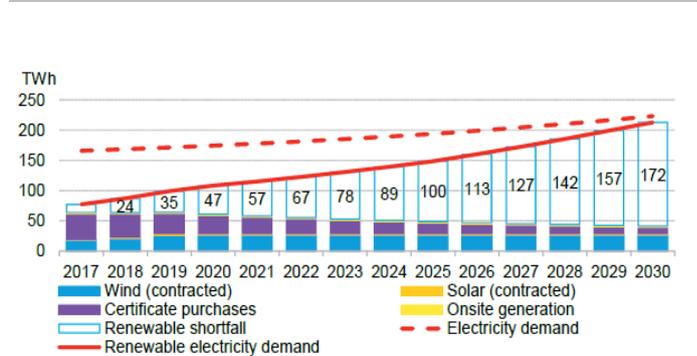
At the same time, the companies currently committed to the RE100 campaign (125 companies from 20 countries committed to 100% renewable power) will need to procure an estimated 172TWh (equivalent to Sweden’s annual power demand) of additional renewable energy generation by 2030 to meet their targets (see Figure 6). If corporations were to meet this demand through Power Purchase Agreements (PPAs), it could catalyse 87GW of new solar and wind build, representing a potential USD 94 billion investment opportunity.

Figure 5. PV module prices have fallen 83% since 2010



Source: Bloomberg New Energy Finance, Maycock

Figure 6. Projected corporate renewable electricity shortfall



Source: Bloomberg New Energy Finance, Bloomberg Terminal, The Climate Group, company sustainability reports. Note: Certificate purchases includes green tariff programs, and are assumed to step down 10% each year. Onsite generation and contracted wind and solar purchases are assumed to remain flat through 2030.

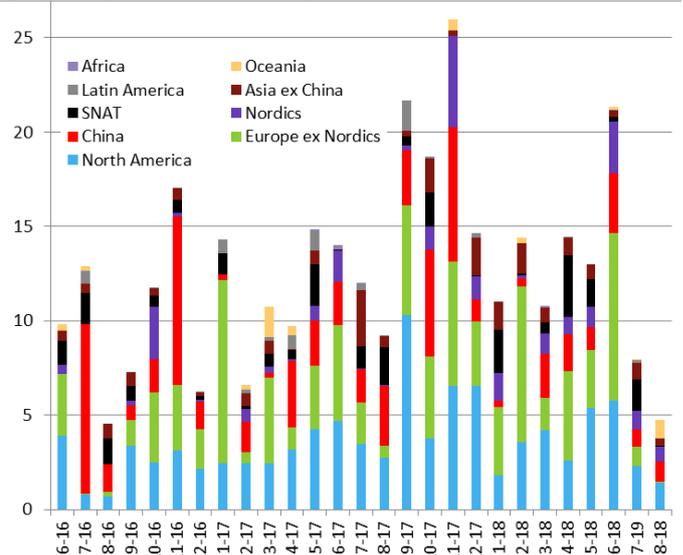
Geographic activity in the green bond market is already very broad and dispersed; with 34 jurisdictions⁴ (excluding Supranationals) featuring green bond issuance in 2018, compared to 40 in 2017 (and 50 in total since 2007). In 1H18, Iceland (Landsvirkjun), Lebanon (Fransa Bank) and New Zealand (Auckland Council) joining the ranks of countries with domestic green bond issuers. In a sign of how the market is diversifying geographically, the top three countries for 2018 in Figure 7 (as well as stalwarts such as Germany and the Netherlands) were all running below their issuance levels from last year.

Figure 7. Top 15 geography by issuance in 2018, incl.

Rank	Geography	YTD 8/2018 (\$ Bn)	Rank Change YoY	Issuance Volume Δ YoY
1	UNITED STATES	23.3	=	-3%
2	CHINA	11.4	=	-25%
3	SNAT	9.6	+1	23%
4	FRANCE	9.3	-1	-37%
5	BELGIUM	6.1	NEW	∞
6	SPAIN	4.9	+4	124%
7	SWEDEN	4.6	=	57%
8	CANADA	3.8	+5	139%
9	NORWAY	3.5	+18	1869%
10	GERMANY	3.4	-5	-11%
11	NETHERLANDS	2.8	-5	-16%
12	INDONESIA	2.0	NEW	∞
13	SOUTH KOREA	1.7	+7	322%
14	JAPAN	1.6	+1	176%
15	ITALY	1.5	-3	-19%

Source: SEB analysis based on Bloomberg and SEB data

Figure 8. Regional distribution of green bond issuance



Source: SEB analysis based on Bloomberg and SEB data. SNAT: Supranational

The center of gravity for the market pulled back somewhat on its shift towards **Europe** in 2018 (Europe still accounted for 45% of 1H18 issuance compared to 37% YoY). An analysis of moving Last Twelve Months (LTM) of green bond issuance shown in Figure 9 visualizes how cumulative LTM figures for Europe (ex-Nordics) have been rising continuously over the last two years to reach USD 53 billion before dipping over the summer back to USD 51 billion, and the Nordics have almost tripled their contribution since October 2017 to USD 17 billion.

As previously described this shift driven by European corporates, financial institutions and sovereigns, has been underway alongside increasing policy attention; as the European Commission adopted its sweeping Action Plan on Sustainable Finance and the Technical Expert Group on Sustainable Finance (TEG) started its work in July on making proposals in relation to the priorities of its Action Plan on sustainable finance. Marie Baumgarts (Head of Group Sustainability at SEB) was elected to the EC TEG and provides an [update](#) on its work in this edition.

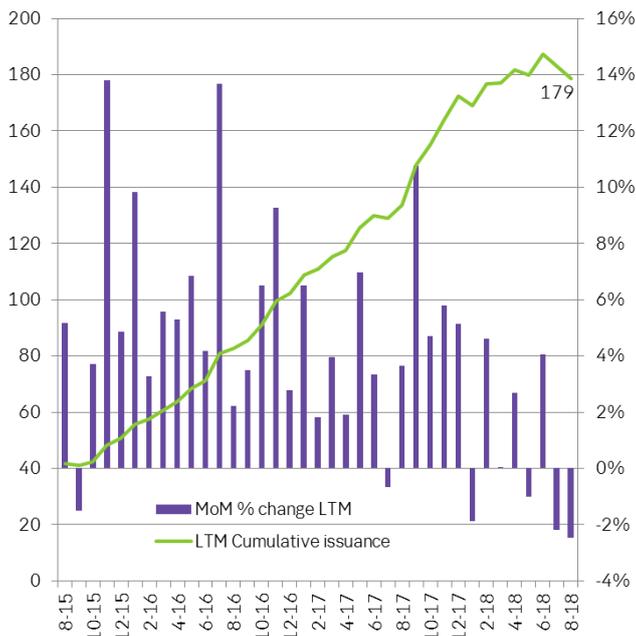
In terms of country rank (Figure 6), with USD 23 billion of issuance YTD the United States rested in familiar first place which it had held all throughout 2017. Green securitisations from five issuers account for 58% of US issuance; with Fannie Mae cataloguing their market leading USD 10.2 billion of green MBS issued through 1H18. In June, SEB had the honor to act as Co-manager and Green structural advisor when Fannie Mae successfully issued a USD 535 million 10-year Green Guaranteed Multifamily Structure (GeMS) mortgage backed security. SRI investors made up for over 40% of the number of participating accounts, a new record for Fannie Mae.

At least three other US-securitisations occurred in 1Q focused on rooftop solar PV as well as PACE receivables. Vivint Solar came to market with the largest single securitization of USD 811 million. In a very positive development for the market sales of green bonds by U.S. corporates in 1H18 jumped over municipals, exceeding their full year 2017 volume already and are on pace for a record year, split between financials (17%) and non-financials (7%). The remaining 16% of the US market came from 25 municipal entities, including San Francisco PUC,

⁴ Classified by Ultimate Parent Country of Risk.

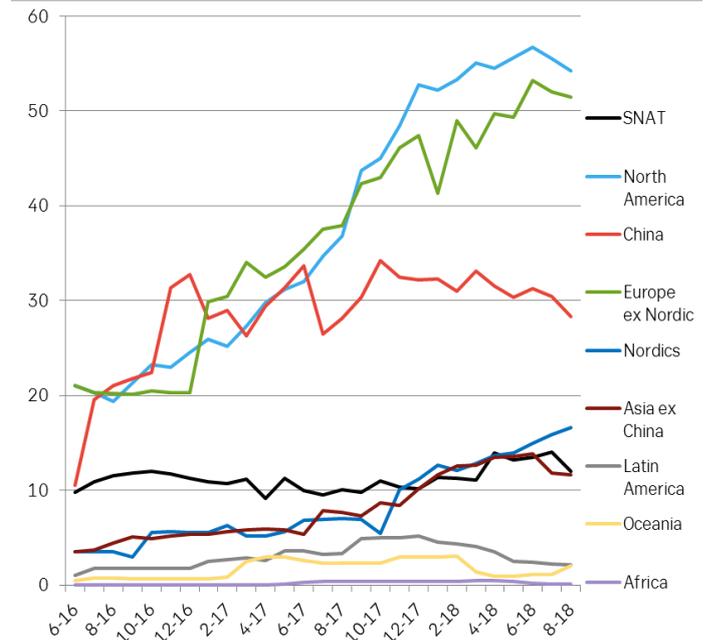
California Infrastructure & Economic Development Bank, New York MTA and D.C. Water; and a handful of project bonds.

Figure 9. Last Twelve Months Analysis / % change (USD Bn)



Source: SEB analysis based on Bloomberg and SEB data

Figure 10. Last Twelve Months Analysis by Region (USD Bn)



Source: SEB analysis based on Bloomberg and SEB data.

As shown in Figure 10, a less serrated, more regular and granulated Chinese market returned to second place, with at least USD 11.4 billion YTD according to Bloomberg figures. The distribution is dominated by corporate borrowers, split between financials (50%) and non-financial corporates (30%); the remainder comes from agencies (such as China Export-Import Bank) along with a burgeoning set of green securitisations. 2Q18 saw the largest quarter for Chinese green ABS issuance with 5 deals totaling USD 659 million.

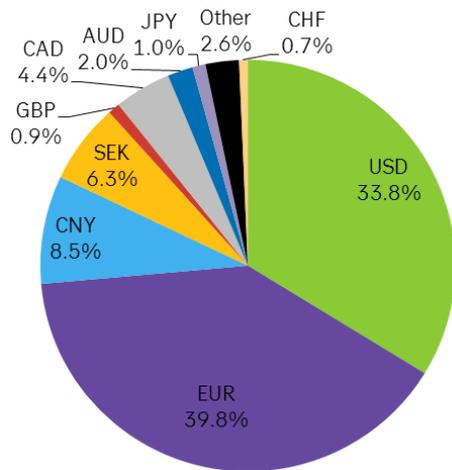
Using Bloomberg figures, Chinese issuance appears to be down 25% YoY; however, official figures show Chinese issuance standing at USD 13 billion (Onshore: USD 7.77 billion/ Offshore: USD 5.25 billion) which would equate to an 11% hike in 1H18. CBI finds that out of the USD 13 billion only USD 9.3 billion meet international green definitions in 1H18; which explains the difference in the numbers. LTM figures in Figure 8 show that Chinese issuance peaked at USD 34 billion and has since been falling, dropping back through the USD 30 billion level over the summer.

At the same time, as can also be seen in Figure 9, LTM issuance from Asia-ex China has almost tripled over the last year, briefly passing Supranationals as a category to touch USD 14 billion in June, with Japan, South Korea, Indonesia, Hong Kong, Singapore, Malaysia and others making increasingly significant contributions as some of these economies add policy incentives to stimulate the market.

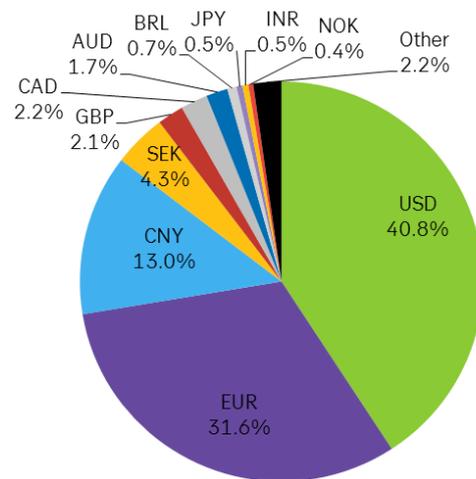
The French green bond market, dropping to fourth place with only seven individual issuers; with the Agence France Tresor's sovereign OAT taking making up a third of the volume and two thirds coming from corporate non-financial (Engie, Paprec) and financials (BNP Paribas, CA-CIB and Fonciere INEA).

Supranationals rose again to third place by rank but by issuance volume were up 23% YoY, with eight multilateral and regional development banks active in a wide variety of currencies and maturities through taps as well as new lines, totaling USD 9.6 billion.

Other notable geographic hotspots include Spain (+124%), Sweden (+57%) surpassing its full year 2017 result half a year in advance, Canada (+139%) and Norway, leaping 18 places in the league tables with issuance soaring 1869% YoY to USD 3.5 billion.

Figure 11. 2018 YTD green bond issuance by currency


Source: SEB analysis based on Bloomberg and SEB data

Figure 12. Cumulative green bond issuance by currency 2007-2018


Source: SEB analysis based on Bloomberg and SEB data. SNAT: Supranational

In terms of currencies (Figures 11-12), the key takeaway from 1H18 was that the market shifted towards Euros, reaching 46% at one point before falling back to 40%. This trend is driven by strength in the corporate EUR market, with financials as well as non-financial corporates, such as utilities, alongside sovereigns favouring EUR. The USD green bond market (34%) made its return to the stage with the retrospective integration of Fannie Mae's green MBS (as they report figures quarterly) and 21 U.S. municipalities. CAD, AUD, and SEK also proved popular currencies to target for supranational issuers raising green capital in 2018. The percentage of all SEK denominated bond issuance in green format surged to a world record of 16% in 2Q18 2018, up from 6.6% over the course of 2017.

SEB's annual regional analysis suggests that 2018 will be a year of consolidation with more modest growth. This is reflected in our base-case scenario showing the market having the potential to grow to **USD 185 billion in 2018**. SEB revised its base case scenario upwards by 7% to reflect the adjustment in Bloomberg's own revisions to its year end 2017 totals (up 7% to USD 173 billion). An analysis of moving Last Twelve Months (LTM) of green bond issuance shown in Figure 9 visualizes how cumulative LTM figures have trended higher over the last two years, surpassing USD 100 billion in January 2017, rising up to USD 185 billion in June but falling to USD 179 billion after the summer.

The SEB USD 185 billion construct for 2018 was arrived at "bottom up" through a sector-by-sector analysis described in edition 1Q 2018 (1) that examines the potential for issuance across geographies and within the categories of Sovereign, Supranational, Agency, Municipal (and sub-sovereign), Corporate, Securitizations, and Project Bonds. However, in order to reach this level of issuance in 2018 given the slow summer, most remaining months would need to exceed prior year records by significant margins. As such, we still see the possibility for higher issuance levels, moving towards the USD 200 billion mark, but we are putting our more hawkish scenarios on hold for the moment.

A waterfall diagram presented in Figure 13 shows how the USD 98 billion of issuance YTD can be broken down by classical public (SSA) and private (corporate and asset level) splits. Sovereign issuance is exceeding our expectations (passing full year 2017 levels already) with seven active issuers, and as such we upgrade our year end potential figure to USD 17 billion, with further upside potential commensurate with the half dozen countries mulling sovereign issues for 2018/19.

Whilst July and August were comparatively slow from an overall issuance perspective, two sectors stood out brightly over these two months 1) financials and 2) municipals.

The corporate green bond market has been particularly buoyant overall with USD 44 billion up by 40% YoY. Financials have been the driving force behind this vitality with USD 27 billion, double the amount of issuance over the same period last year. Financials look to be on track to exceed our estimate based on the assumptions we set in place at the beginning of the year. The issuance of green covered bonds grew strongly in 1H18 with four new bank issuers in 2018 taking the total to USD 6 billion outstanding from seven issuers. This trend looks set to continue

with vigour in 2018 and beyond as the financial case behind green mortgages continues to strengthen. In May, [SEB launched Green Mortgages](#), offered with a 10 basis point reduction on the interest rate paid to anyone with housing that Sweden's National Board of Housing, Building and Planning have assigned an A or B rating for energy efficiency.

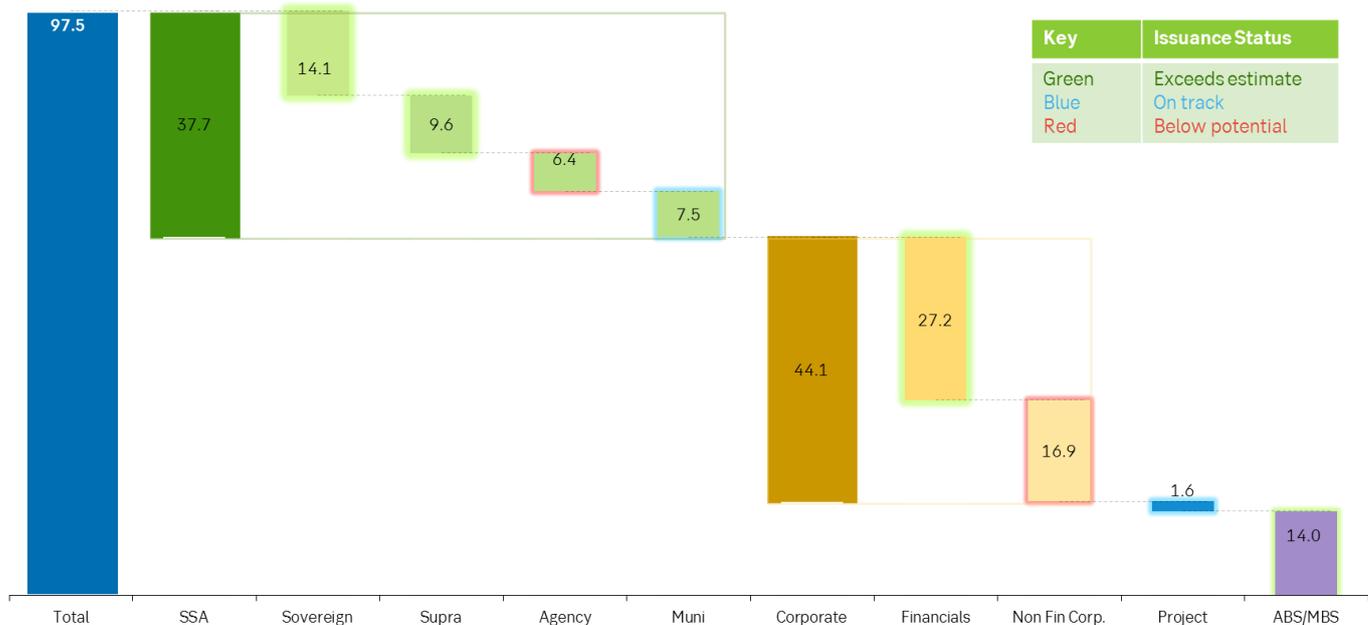
After a decent 1H (up 8%), non-financial corporates lagged somewhat over the summer as discussed above to reverse themselves to -8% YoY. We believe this level of issuance is well below its potential, due to the fact that some truly expansive geographies and sectors have yet to even get going.

Supranationals have been exceeding expectations all year, up 66% YoY, and reaching 2017 full year issuance figures over the summer. As such, we upgrade this sector to USD 14 billion for 2018. However, issuance from agencies (such as National Development Banks and other domestic public financial institutions) has fallen further away from its potential almost every month, with issuance levels half of what they achieved last year. We continue to hold agencies on watch for a downgrade to their potential for 2018 issuance.

Municipalities had been quiet most of the year causing us to put them on watch for a downgrade, but they woke up suddenly over the summer with issuance in July rising over 400% YoY to bring their levels to +3% YTD at USD 7.5 billion.

With regards to other types of green bond issuers, securitisations appear to be well on track up by 8% YoY at the end of August. Finally, it had been a fairly busy year to date for green project bonds, which are also proving popular financing mechanisms in emerging and developing economies, but issuance cooled over the summer.

Figure 13. Green bond issuance in 2018 by sector and sub-sector (USD Billion)



Notes: ABS/MBS = Asset Backed Securities/Mortgage Backed Securities; SSA = Sovereign, Supranational, Agency and Municipal, Regional and other sub-sovereign; Financials include Real Estate and Insurance; N-F Corp. = Non-Financial Corporates. SEB uses the BICS sector classification system with some adjustments using Bloomberg/MSCI green bond sector classifications. Bloomberg (see Guide to Green Bonds on the Bloomberg Terminal) methodologies used to qualify green bonds, including Schuldscheine and private placements, and excluding pure plays.

Source: SEB analysis based on Bloomberg/BNEF and SEB data.

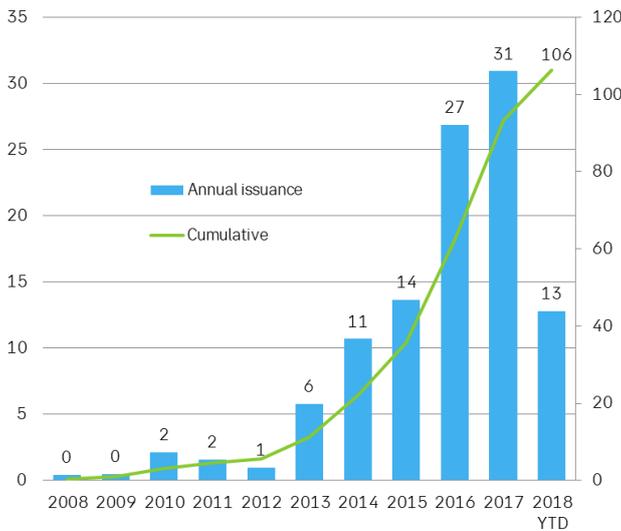
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Green Bonds and Water

As an overall market comment, to coincide with Stockholm World Water Week, we are for the second time presenting an indicator for where green bonds are used for water, and can conclude that an increasing amount of green bond financing is indeed including water as a potential investment category. As shown in Figures 14-15, out of the green bonds checked by SEB, USD 106 billion (or around 20%) worth of green bonds from 103 individual issuers had selected the Green Bond Principles (GBP) category of “Sustainable Water & Wastewater Management” as one of their use of proceeds in their green bond framework.

Volumes and number of issuers have been swelling steadily along with the growth of the overall green bond market; rising from US 14 billion (from 33 issuers) in 2015 to USD 27 billion (from 45 issuers) in 2016 and hitting a high water mark of USD 31 billion in 2017 (from 64 issuers). As of August 2018, the market for green bonds with water eligibility was on track for another full year with USD 13 billion so far by 33 issuers; and bearing in mind that the majority of this type of bond issuance occurred in the second half of the last two years.

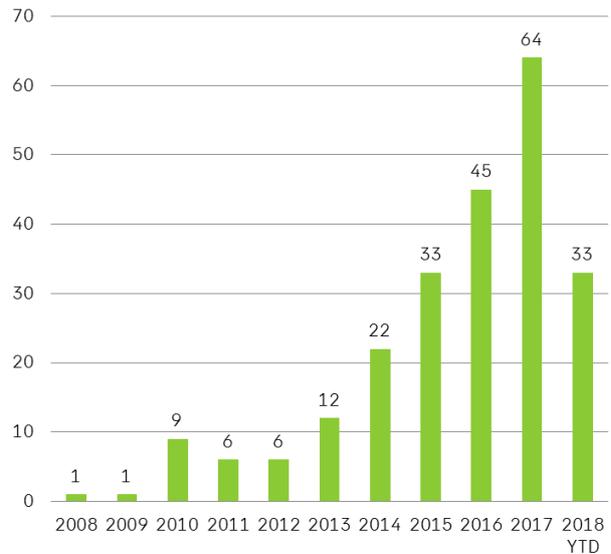
Figure 14. Green bonds with water eligibility* (USD Bn)



Note: Note: Indicative figures. *Green bonds identified by SEB as having Green Bond Principles project category of “Sustainable Water & Wastewater Management” as a Use of Proceeds. Note that it is not possible to break out allocations to water, and not all proceeds of bonds will be dedicated to water. Other GBP categories involve water as well, e.g. pollution prevention & control, renewable energy, etc.

Source: SEB analysis based on Bloomberg/BNEF and SEB data

Figure 15. Green bonds with water eligibility (# of issuers)



Note: Note: Indicative figures. *Green bonds identified by SEB as having Green Bond Principles project category of “Sustainable Water & Wastewater Management” as a Use of Proceeds. Note that it is not possible to break out allocations to water, and not all proceeds of bonds will be dedicated to water. Other GBP categories involve water as well, e.g. pollution prevention & control, renewable energy, etc.

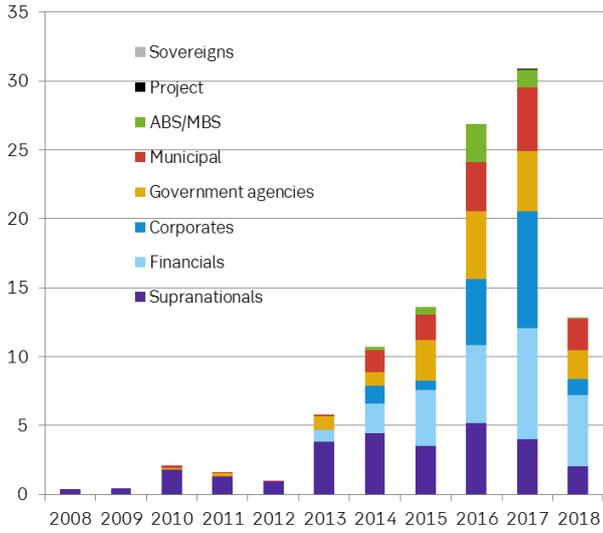
Source: SEB analysis based on Bloomberg/BNEF and SEB data

In the absence of comprehensive ex-post reporting information, breaking out actual allocations to water-related investment for the whole market remains a challenge, and clearly not all of these proceeds of bonds will be dedicated to water (as it is most often one category among others). However, there are other GBP categories where water is implicated as well to varying extents, e.g. terrestrial and aquatic biodiversity conservation, pollution prevention & control, renewable energy, green buildings, etc., so there is reason to believe that water is indeed a major beneficiary of green bond financing. For instance, the French sovereign green OAT includes all of these GBP categories in their framework.

As highlighted in Figures 16 and 17, supnationals are the most ubiquitous as well as long-standing category of issuer including the GBP water category in their frameworks, starting with the World Bank’s first green bond a decade ago, and have issued USD 28 billion over the period. However, financials have nearly caught up in only the last few years flowing past the USD 25 billion mark. Non-financial corporates also poured into the market alongside financials to pass government agencies in 2017, both sectors accounting for USD 16.5 billion of issuance.

A handful of ‘pure play’ water bond issuers are also present in the market, such as the NWB Bank (the Dutch Water Authorities bank), Anglian Water, as well as a number of U.S. municipal entities such as D.C. Water and San Francisco Public Utilities Commission which tap the green bond markets for water investments. Indeed, one category where the actual allocations are clearer is in the overarching area of U.S. municipal green bonds, where according to BNEF it is apparent that water accounts for at least 80% of use of proceeds in 2017. Other issuers have innovated with thematic labels e.g. ‘blue bonds’ such as from the World Bank in 2017.

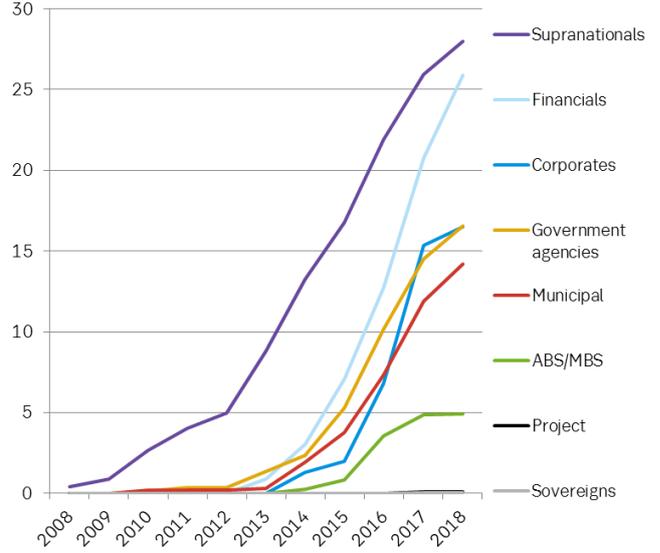
Figure 16. Green bonds with water eligibility: Sector (USD Bn)



Note: Note: Indicative figures. *Green bonds identified by SEB as having Green Bond Principles project category of "Sustainable Water & Wastewater Management" as a Use of Proceeds. Note that it is not possible to break out allocations to water, and not all proceeds of bonds will be dedicated to water. Other GBP categories involve water as well, e.g. pollution prevention & control, renewable energy, etc.

Source: SEB analysis based on Bloomberg/BNEF and SEB data

Figure 17. Cumulative water eligible issuance: Sector (USD Bn)



Note: Note: Indicative figures. *Green bonds identified by SEB as having Green Bond Principles project category of "Sustainable Water & Wastewater Management" as a Use of Proceeds. Note that it is not possible to break out allocations to water, and not all proceeds of bonds will be dedicated to water. Other GBP categories involve water as well, e.g. pollution prevention & control, renewable energy, etc.

Source: SEB analysis based on Bloomberg/BNEF and SEB data

2. Publicly Announced Green, Social & Sustainability Bond Pipeline⁵

- AFD
- Al Omrane (Dirham)
- Banco Nacion Argentina
- Bank Australia
- Credit Suisse (EUR)
- City of Vancouver
- EIB Sustainability Bond
- Epsa
- Gussing Renewable Energy International
- IREDA (Green Masala)
- Korea East-West Power
- MA Clean Water Trust
- Macquarie University
- Mexico City (MXN)
- Monash University
- Nigeria Green Sovereign (Tap)
- Nigeria sovereign
- Scottish and Southern Energy (SSE)
- State Bank of India (USD)
- Walloon Region

⁵ As of 28 July 2018



3. Technical Expert Group on Sustainable Finance (TEG) – State-of-play, July 2018⁶

Marie Baumgarts

Head of Group Sustainability, & SEB delegate elected to the EC-TEG

Christopher R. Kaminker, PhD

Head of Research, SEB Climate & Sustainable Finance

On 5 July 2018, the members of the newly-created Technical Expert Group on Sustainable Finance kicked off the work on four key actions outlined in the Commission's Action Plan on Financing Sustainable Growth.

The recently established Technical Expert Group on Sustainable Finance (TEG) has had two plenary and two sub group meetings for each of its four workstreams since its inception in early July. These meetings focused on the mandate and deliverables of the group as well as the key questions surrounding the group's four tasks, which are to assist the Commission in developing:

- an EU classification system – the so-called taxonomy – to determine whether an economic activity is environmentally sustainable;
- an EU Green Bond Standard;
- benchmarks for low-carbon investment strategies; and
- guidance to improve corporate disclosure of climate-related information.

The TEG will continuously consult with the European Commission on existing and future environmental and climate policy developments, to ensure proposals that are dynamic and synchronised with technology and policy innovation. The sub groups will also be mindful of other non-EU developments in sustainable finance. Each task and product of the TEG is meant to provide a strong contribution to the EU's competitiveness as it transitions to a low-carbon, sustainable economy.

Taxonomy

To encourage sustainable growth, industry, investors and governments need a clear understanding about which economic activities are environmentally sustainable. Currently, no classification system exists at EU-level and market-led initiatives of recent years are not comprehensive enough to sufficiently reflect all EU environmental and broader sustainability priorities. An EU taxonomy, commencing with definitions of environmentally sustainable activities will build on similar, existing market-led and Member State-based initiatives. The aim of such a system is to facilitate the achievement of the EU's mid- and long-term GHG emissions targets and environmental policy objectives by encouraging capital flows to environmentally sustainable economic activities. The taxonomy will serve as the basis for the future establishment of standards and labels for sustainable financial products that provide sustainable capital flows.

In May 2018, a proposal for a regulation on the establishment of a framework to facilitate sustainable investment was put forward by the Commission. The proposed regulation provides the framework for the taxonomy work of the TEG.

The proposed regulation is expected to be discussed and negotiated by the European Parliament and Member States over the course of 2018 and 2019. Once adopted, the legal text should empower the Commission to adopt delegated acts containing a list of environmentally sustainable activities, together with their technical screening criteria. This would be based on the report provided by the TEG in June 2019, which would also include an explanation of how the sectors were selected, the determination of technical screening criteria in compliance with the taxonomy proposal, as well as an analysis of the potential economic, financial and environmental impacts.

Progress achieved

With a view to building on existing initiatives, the group members focused the first two meetings in July on reviewing the work carried out in 2017 and 2018 by the Commission's High-Level Expert Group on Sustainable Finance (HLEG) (in particular the climate change mitigation taxonomy publicly available here) together with commercially available taxonomies (e.g. Climate Bond Initiative). The group also discussed using existing EU statistical classifications of economic activities and products (NACE and CPA), as well as EU environmental classifications (e.g. CREMA and CEPA), for developing the taxonomy.

⁶ EC Press Release: Available at https://ec.europa.eu/info/sites/info/files/180730-teg-statement_en.pdf

The group members will work during the summer on mapping the existing classifications and proposing a sector framework that would best serve the main users of the taxonomy (financial market participants), as well as facilitate the future tracking of financial flows to sustainable investments. Further preparatory work over the summer includes:

- gathering and synthesising available information on mitigation and adaptation-related economic activities (e.g. first two environmental objectives);
- developing knowledge on dealing with trade-offs between environmental outcomes and thresholds (i.e. 'not significantly harming' principle);
- devising a strategy on obtaining expert input and stakeholder feedback.

EU Green Bond Standard

Green bonds allow issuers to seek funding from investors in order to finance or re-finance 'green' projects, assets or business activities. Building on the EU sustainability taxonomy and drawing on current best practices, an EU Green Bond Standard can protect the integrity of and trust in the green bond market, by giving guidance to issuers as well as enabling easier access for investors seeking such a product.

Progress achieved

The members of the subgroup on the EU Green Bond Standard (GBS) have started the work on the guiding principles that could form the basis for such a standard, based on approaches that are currently present in the market. Experts deliberated some of the potential issues that will need to be addressed, such as external review and verification processes and reporting.

It was agreed that the EU GBS would draw on the EU taxonomy to be developed by the taxonomy subgroup with an external verification process envisaged, as is common practice for green bonds in the EU market already today. Discussions regarding the granularity of requirements placed upon the verification process and the scope of the EU GBS are ongoing. Given the relatively well-developed EU market for green bonds, the EU GBS could focus on maintaining and reinforcing market integrity and establishing the basis for a recognised international standard.

The group decided that their report would encompass the following three thematic sections (i) purpose of green bond standard; (ii) main features of the standard; and (iii) external reviews and reporting. Links to other frameworks, actions and working groups will be taken into account. Topics like additionality and incentives for issuing green bonds will be subject to further evaluation.

Benchmarks

Benchmarks play a central role in the price formation of financial instruments and provide a useful tool for investors, as they allow tracking and measuring performance and allocating assets accordingly. Traditional benchmarks reflect the status quo and their methodologies, as a result, reflect sustainability goals only to a limited degree. Existing ESG benchmarks lack transparency with regards to their methodologies and fund managers pursuing a low-carbon or Paris-aligned investment strategy lack a reliable index to benchmark their performance against.

Progress achieved

The subgroup has started discussing selection criteria, data needs, and weighting methods for underlying assets of such benchmarks. This includes determining the key elements of minimum standards for low-carbon and positive carbon impact benchmarks.

The importance of ensuring the comparability and reliability of data used for the construction of these benchmarks is clear. In this context, the experts have started deliberations on the various greenhouse gas emission scopes (1, 2 and 3) to develop the positive carbon impact benchmark. As part of that, clear definitions of the benchmark objectives have been identified as success parameters: The low-carbon benchmark (LCB) would be used for risk diversification and positive carbon impact benchmark (PCIB) for investing with impact.

Climate-related disclosures

In the context of the update of the non-binding guidelines of the Non-Financial Reporting Directive (NFRD), the TEG has started to work on the question of how to improve climate-related disclosures.

The aim of the work is to help investors make sound investment decisions. This can be achieved by improving transparency and comparability of climate-related information that is

provided by market actors. Ideally, clear and transparent climate-related disclosure leads to more insight into how climate risks and opportunities may influence return on investment. As such, it will also help investors to make better investment decisions while understanding their impact on climate change.

Progress achieved

The findings of the group will feed into a report on climate-related disclosures, which may include additional information. For example, the different ways in which disclosed data can be used by the investment community may be relevant to be included in the TEG's report as well. Starting points for the work are the existing guidelines to the NFRD and the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD). The work of the group will build on and further develop the TCFD recommendations. For example, the group has also taken up the challenge of identifying disclosure metrics that could give meaningful information about the impact a company has on climate change. Both climate change mitigation and adaptation are part of the scope.

4. City of Gothenburg: 5 Years of Green Bonds

Happy birthday, already five years and going stronger than ever. In September 2013, City of Gothenburg became the first municipality in the world to issue a green bond. The market was almost nonexistent when we first heard about it. It all started with an invitation from SEB to attend a presentation from the World Bank speaking about green bonds. The reason was that we should invest in Green bonds for our old foundations, but on our way back home from Stockholm we asked ourselves if the city could issue a bond like this.



**City of
Gothenburg**

Magnus Borelius
Head of Treasury
City of Gothenburg

Note that this text is provided by the contributing party and constitutes the opinion of the party and not necessarily that of SEB. SEB plays a role in enabling its stakeholders to benefit from a broad overview of initiatives by allowing key market participants to contribute through The Green Bond.

With help from the bank we decided to give it a try. It was anything but easy and we had many questions. So many, in fact, that we postponed the first transaction. It was supposed to take place just before summer. We asked ourselves: Would there be any interest from investors? Do we have enough projects? And so on and so forth. After the summer, curiosity was insurmountable and we had to try. None of us had dared to dream about the interest and trust the investors showed us.



**Göteborgs
Stad**

Läs mer på seb.se/greenbonds

En investering i en bättre miljö

SEK 500,000,000 Göteborgs Stads Gröna Obligationer

Investerare

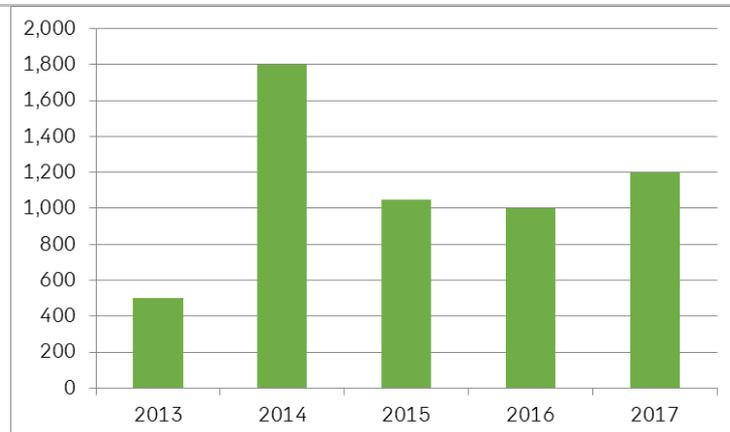


Lead Manager Skandinaviska Enskilda Banken AB (publ)
Miljöinvestering till marknadsränta

SEB

Since that day, the interest and the market for green bonds has just continued to grow and we have issued a green bond each year. Our total outstanding amount is now SEK 5,55 billion (the total outstanding amount of our bonds is 40 billion) and the strategy is to continue to increase the proportion of green bonds in our funding portfolio.

Green bonds issued amount (SEK Mn)



Source: City of Gothenburg

If I would summarize the first five years with one single word, it would be “co-operation”. From the beginning, investors, banks and issuers have worked together towards the common goal that the market will grow in a robust and transparent fashion. And also the cooperation we have had within the organization. Five years ago, nobody in the organization knew what green bonds were. Today it is in the city’s budget that “The work with issuing green bonds shall continue to develop.” An example of how an idea has evolved into a group strategy. We have also received questions from citizens if it is possible to buy the bonds. This is something that never happens with the other bonds. The most long-distance call we received was from a man running a grocery store in South Africa.

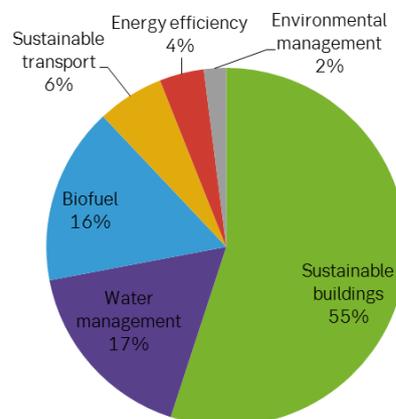
Much has happened and the difference today is that in the beginning there were not many who believed in it. The most common questions we received at the beginning were “Why are you

doing this? You who are AAA rated have no trouble borrowing money”, “Why do the extra work (impact report) when you don’t have to?” and “How do you define green ?” Our simple answer was that we have an idea but we do not have all the answers yet. The advantage of being the first in the world is that all answers were not available, but you have to make suggestions yourself. We were a bit surprised that for quite some time there were so few players around the table. The cooperation between market has been good from start and after a while the number of participants increased.

Transparency and consistency is important for us and we focus hard on impact reporting. Five years ago, the report was just one page and described briefly the impact and how the proceeds were allocated. For each year the report has grown to an extent, but it has still been very much up to each issuer how the projects are to be reported. Last year we tried to focus more on harmonization. Together with nine other Nordic public sector issuers we released a joint paper on green bonds impact, “[Position Paper on Green Bonds Impact Reporting](#)”. The position paper proposes an outline for reporting environmental benefits of green bond investments, a practical guide for impact reporting. Gothenburg’s [report for 2017](#) is in accordance with the paper and we hope it is of interest and value to investors.

We see benefits both to investors and issuers from a harmonization of impact reporting. We are committed to deliver a report at a manageable level and will continue to develop the joint paper. It is also important to be aware that if you have too much regulation and do it too extensively, it can be a barrier for new issuers to enter the market. It also raises the question of if and when the impact reporting requirements become too extensive, making green bonds a viable instrument only for large institutions. Small organizations don’t have the extra resources. The challenge for Gothenburg in terms of impact reporting is the wide variety of businesses within the city and the city-owned companies. Project categories, based on the city’s environmental program, include among others; sustainable housing, waste management and sustainable transportation. Proceeds from green bonds have been allocated to very different projects. Everything from small projects like tree planting to bigger ones like denitrification systems. The largest project category today is sustainable buildings with a share of 55% of allocated proceeds.

Green Projects 2013-17, Based on disbursed amounts



Source: City of Gothenburg

Green bonds have changed our relation to the investors. As a complement to the impact report, we have also had events where we together with investors visited different projects funded with green bonds. One-on-one meetings with investors are also very welcomed where we get an opportunity to describe our work in more detail.

At the beginning, the projects were few and large, and it was easy to manage the process in terms of collecting facts and figures from the city owned Companies. Now when we have taken the green bonds from a standalone project at the treasury department to a group level the cooperation between different departments has become more and more important. I would say it is a key factor for future success. Five years ago, we at the treasury department tried to do everything by ourselves. We learned pretty fast that this was not the most efficient way. Our colleagues at the environmental departments are much more suitable to handle the green part

of the green bonds and the quality of the work also increases. And most important, the colleagues at the treasury department shall not be experts in environmental issues and vice versa. Something we must remind ourselves of every now and then, even if it's fun to discuss each other's issues and we benefit from the mutual competence enhancement.

During our five years in the green bond market we have experienced and participated in activities that we could never have imagined. Everything from speaking at events to hosting workshops at United Nations COP conferences. The biggest moment so far was when we received the United Nations Momentum for Change Lighthouse Activity award. Each year UN Momentum for Change recognizes inspiring action on climate change, selecting the most innovative and transformative climate solutions from around the world. A lesson we learned is that if you become the first, you also become an expert. Whether you want it or not. We have always tried to share our knowledge as much as possible and this has given us a large network that challenges us and our ideas.

**UN Climate Solutions Award 2016 Momentum for Change:
Gothenburg Green Bonds**



Now it is happy days for the green bond market and everyone wants to be a part of it. I am happy to see that the market has grown so much. But at the same time the critical voices are becoming more important so that we can keep the discussion alive and develop the market. It is still very fragile and more regulations will not be a silver bullet solution even if they are important. It has been great to be part of this development and we will do our best to contribute to future success for green bonds.

Nick Robins

Professor in Practice – Sustainable Finance at LSE's Grantham Research Institute and Special Adviser in Sustainable Finance, UN Environment

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5. New Frontiers in Sustainable Finance

Living in Unthinkable Times

We are living in unthinkable times. The unimaginable heat across the Northern hemisphere this summer reminds us once again of the huge costs that even moderate levels of global warming can bring. If there's one message from this scorched earth summer, it is we need to accelerate the transition to a zero-carbon and resilient economy.

For this, we have to harness the full capacity and expertise of the financial system. Here there is momentum across the board – with developments underway that would have been unthinkable just a few years ago.

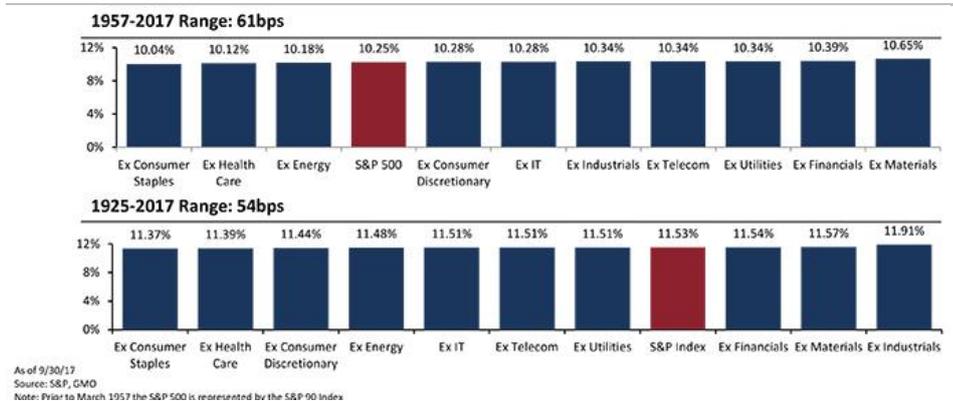
New markets are powering ahead not least in the fixed income space with green, social and now sustainability bonds, pioneered by SEB and others. But as we know from our diets, simply eating greens alone doesn't do the job. We also need to cut out the carbs and in sustainable finance this means reallocating capital away from increasingly high-risk carbon intensive assets.

Divestment is one strategy for doing this; shareholder engagement to redirect retained earnings to green opportunities is another. One of the concerns investors have had is how to withdraw from carbon assets without affecting tracking error against conventional benchmarks. Investment pioneer Jeremy Grantham has recently examined the evidence in an article for the LSE's Sustainable Finance Leadership series. His conclusion illustrated in this chart is that "if investors take out fossil fuel companies from their portfolios, it will have very little effect and is just as likely to be positive by 17 basis points as negative".

<http://www.lse.ac.uk/GranthamInstitute/news/the-mythical-peril-of-divesting-from-fossil-fuels/>

This conclusion would have been unthinkable a couple of years back. Now it is becoming part of the new norm of sustainable finance.

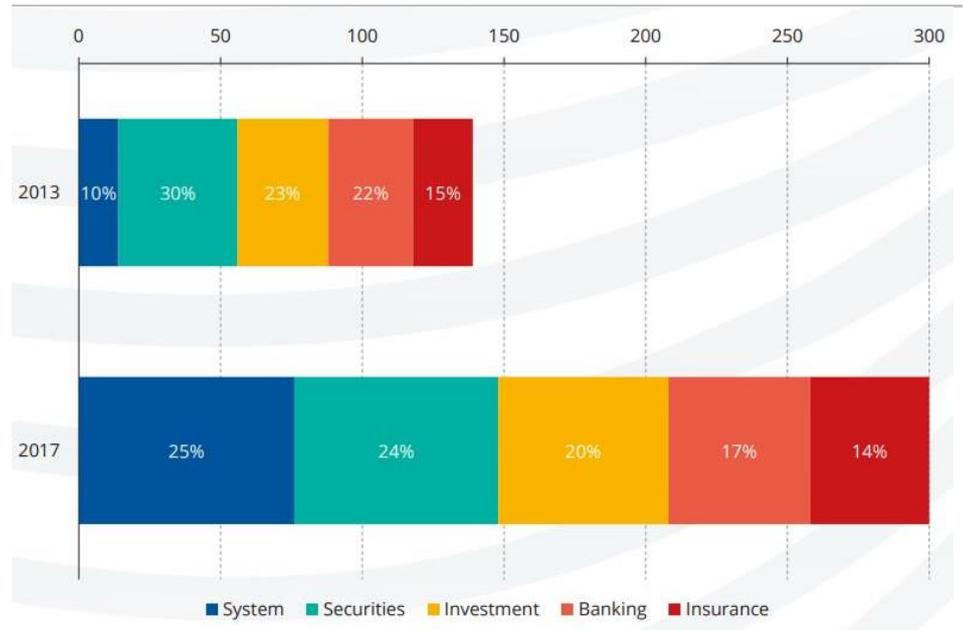
Figure 5.1 Yes, you can divest from oil – or anything else – without much consequence



Source: GMO, Jeremy Grantham White Paper

A doubling of green finance policies and measures in the past 4 years

Policymakers and regulators are also sending signals about how climate and sustainability factors will be managed in the financial system that also earn the tag 'unthinkable'. I was delighted to be co-director of UN Environment's Inquiry into the Design of a Sustainable Financial System for four years. Our final report concluded not just that a sustainable financial system needs to be a shared goal, but that steps towards this are already underway. Indeed, the number of measures to take account of climate and sustainability factors in financial policy and regulation doubled between the end of 2013 and the end of 2017. Strikingly, the biggest shift has been the introduction of a growing number of system-wide initiatives, not least China's wide-ranging strategy for green finance, the EU's action plan on sustainable finance and, most recently, Canada's expert group on sustainable finance. All of these look beyond individual issues and asset classes and seek to move the system as a whole.

Figure 5.2 The Doubling in Policy and Regulatory Measures 2013-2017

Source: McDaniels, J. and Robins, N. (2018) <http://unepinquiry.org/publication/greening-the-rules-of-the-game/>

Green Finance is a Team Sport not a Solo Race

This shift is leading to new roles for central banks and supervisors. Here, a growing number of ‘policy entrepreneurs’ are emerging. One of these is Frank Elderson, board member of the Dutch central bank, DNB. Following the financial crisis of 2008, DNB broadened its mandate to focus on ‘sustainable prosperity’ and has since been focusing on the implications, focusing on climate change risks. Importantly, international cooperation is key to progress among central bankers as it is for green bond growth.

Here, another unthinkable initiative is gaining traction, the new central bank and financial supervisor Network for Greening the Financial System. Launched at the 2017 One Planet Summit, the NGFS aims “to manage risks and to mobilise capital for green and low-carbon investments in the broader context of environmentally sustainable development.”

Its membership continues to grow and now has 13 leading public authorities, including Banco de España, Banco de México, Bank Al Maghrib, Bank of England, Banque de France / Autorité de contrôle prudentiel et de résolution (ACPR), Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin), De Nederlandsche Bank, Deutsche Bundesbank, European Central Bank, Finansinspektionen (Swedish FSA), Monetary Authority of Singapore, Oesterreichische National Bank, and the People’s Bank of China. The Network is currently focused on three workstreams: micro-prudential supervision; macro-financial management; and scaling up green finance.⁷

Frank Elderson is also the chair of NGFS and in his article for LSE’s Sustainable Finance Leadership Series, Frank Elderson stressed the importance of this shared way of working, arguing “I cannot stress the importance of these activities enough. The stability of the financial system and climate change are issues that, by their very nature, cross borders. Greening the financial system is not an individual race, but rather a team effort.”⁸

Financing the Just Transition

⁷ <https://www.banque-france.fr/en/communiqu-e-de-presse/publication-mandates-ngfs-technical-workstreams-and-expansion-ngfs-membership>

⁸ <http://www.lse.ac.uk/GranthamInstitute/news/from-mission-to-supervision-putting-sustainable-prosperity-on-the-agenda-of-the-dutch-central-bank/>

As both investors and regulators work through the strategic implications of climate change and sustainable development, there is growing awareness that a silo'd approach doesn't really work. Close linkages exist between taking action on climate and the other 16 Sustainable Development Goals. In fact, it's becoming increasingly clear that while climate change can easily be classified as an environmental issue, the transition to a zero-carbon, resilient and sustainable economy is actually a process of structural change. This brings with it a host of economic and social opportunities and risks.

At a macro level, it's clear that the benefits of the transition will far outweigh the costs. Managed well, the transition will generate additional high-quality jobs and reduce inequality. But there will still be significant transitional implications for key sectors, regions and countries. Poorly managed, this could result in "stranded workers" and "stranded communities" as well as "stranded assets," slowing the transition itself, while contributing to economic stagnation and potential instability.

To overcome this challenge, the goal of a just transition for workers and communities was included as part of the Paris Agreement on Climate Change. A growing number of trade unions, governments and businesses are now taking action to make this a reality - in essence, delivering decarbonisation with inclusion. Over the past year, leading investors have recognised the need to take action too. So far, however, there is a lack of robust analytics and guidance to enable investors to play an effective role.

The Investing in a Just Transition initiative aims to fill this gap. Designed by the Grantham Research Institute at the London School of Economics and the Initiative for Responsible Investing at the Harvard Kennedy School the initiative aims to make the case for investor action and set out practical options for action. Importantly, the initiative is being delivered in partnership with the UN-backed Principles for Responsible Investment as well as the International Trade Union Confederation.

Already a compelling case for investor action is emerging, connecting issues of systemic risk, material value drivers, beneficiary interests and alignment with societal goals such as the SDGs. Equally, an investor roadmap is becoming clear, involving integration in investment strategy, shareholder engagement, capital allocation plans (such as green bonds targeted in high-carbon regions as well as policy advocacy and place-based partnerships). A first discussion paper has been released and an investor guide will be launched at the 2018 climate COP in Katowice.⁹

Once again, this investor focus on the just transition is a sign of sustainable finance becoming more mature, rising to the challenge of the unthinkable times we live in.

⁹ <http://www.lse.ac.uk/GranthamInstitute/publication/investing-in-a-just-transition-why-investors-need-to-integrate-a-social-dimension-into-their-climate-strategies-and-how-they-could-take-action/>

Knut Alfsen, PhD
Senior Researcher
CICERO, University of Oslo

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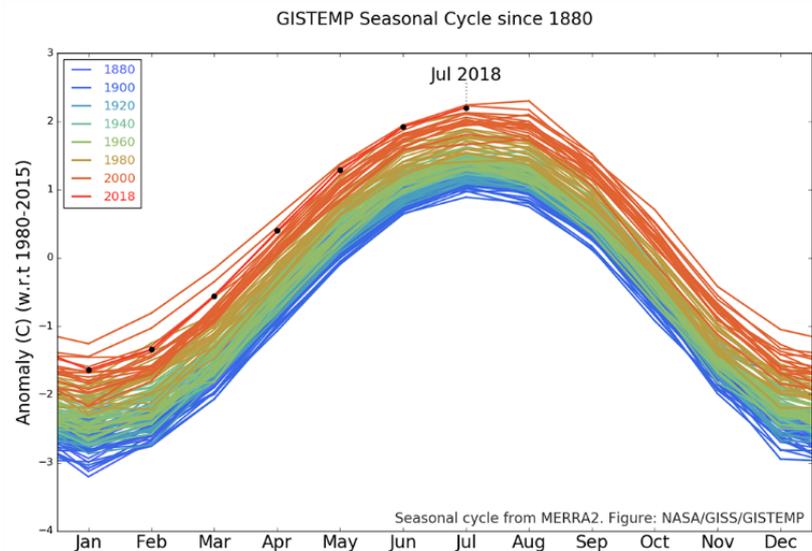
6. Science update from CICERO: After a long hot summer

The summer of 2018: Hot, but how hot?

A long hot summer has brought media attention to climate change. Hundreds of news articles about drought and record temperatures in Northern and later Southern Europe were eventually topped by the news of a study by Will Steffen and co-authors warning that a 'hot house' may be coming. A 'hot house' is a state of Earth's climate where internal feedbacks in the climate system force higher temperatures even though human drivers of greenhouse gas emissions have ceased. It helped, of course, that Johan Rockström of Planetary Boundaries fame and several other famous scientists were among the authors. Before coming to this study however, let's take a look at what data tells us about the summer of 2018. Of course, the summer is not quite over yet, but we have data for the early summer months.

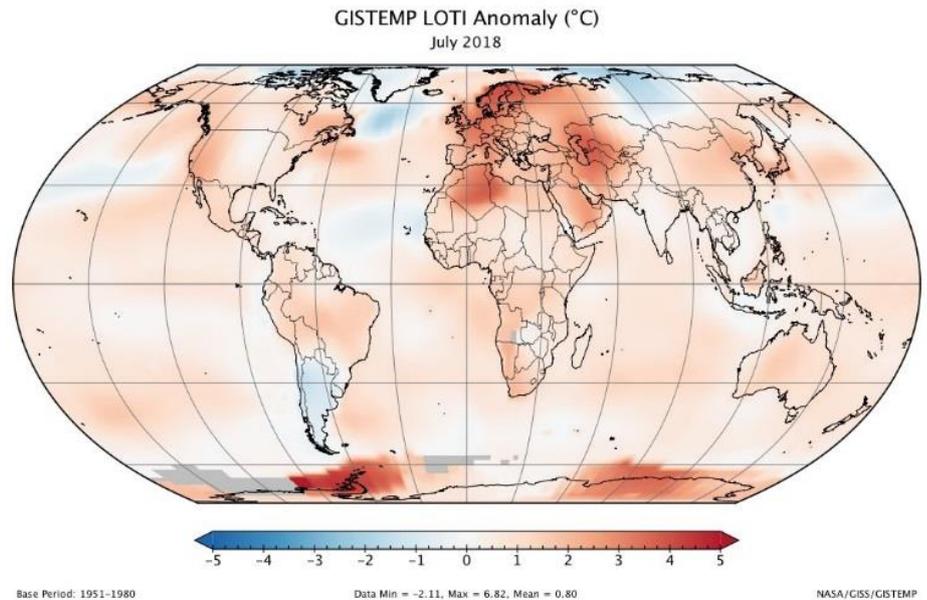
Figure 6.1 shows monthly global mean temperatures as published by NASA. July is clocked in as the second highest July temperature ever. Other institutions (e.g. NOAA) have July in third place.

Figure 6.1 GISTEMP Seasonal Cycle since 1880



Source: NASA – GISS, <https://data.giss.nasa.gov/gistemp/>

Figure 6.2 shows the regional distribution in July. As we see, it was pretty warm in Europe with several local temperature records, in particular in the north, while the Arctic and the Southern hemisphere are considerably colder relative to expectations. Overall, 2018 is therefore not on track to become a record hot year, but will certainly take place among the top five, all of which have taken place after 2010. That the El Niño event, that semi-regularly takes place in the Pacific and that tends to raise the global temperature, is absent in 2018, makes the high temperature noteworthy.

Figure 6.2 GISTEMP Seasonal Cycle since 1880


Source: NASA – GISS, <https://data.giss.nasa.gov/gistemp/>

Hot house

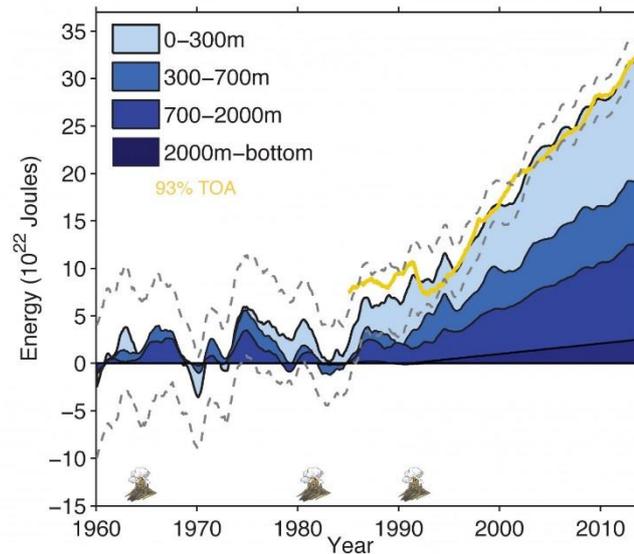
The study by Will Stephen and co-authors have also got a lot of media attention, although strictly speaking, the study does not really represent any new science. Rather it is an opinion piece, or ‘perspective’ as they call it, from scientists warning that a number of feedback mechanisms associated with for instance loss of ice and snow, and loss of carbon from forests and soils, may drive the global temperature higher even in the absence of human emissions of greenhouse gases. The feedback mechanisms are well known, but difficult to quantify, so the warning is against a potentiality, not something we know will happen for certain. The high media attention even in the absence of new science can perhaps best be understood on the background of the hot summer in the Northern hemisphere.

Hot also off-shore

It’s not only getting hotter on land. It is well known that most of the surplus energy that the greenhouse effect generates goes into the oceans. The next figure (Figure 6.3) shows this as well as the distribution across different depths. The yellow line is an estimate of the energy imbalance at the top of the atmosphere. As we see, most of this surplus is dumped in the ocean – year after year.

The consequence of this is an increased frequency and intensity of so-called Marine Heatwaves (MHWs). These are periods of extreme warm sea surface temperature that persist for days to months and can extend up to thousands of kilometres.

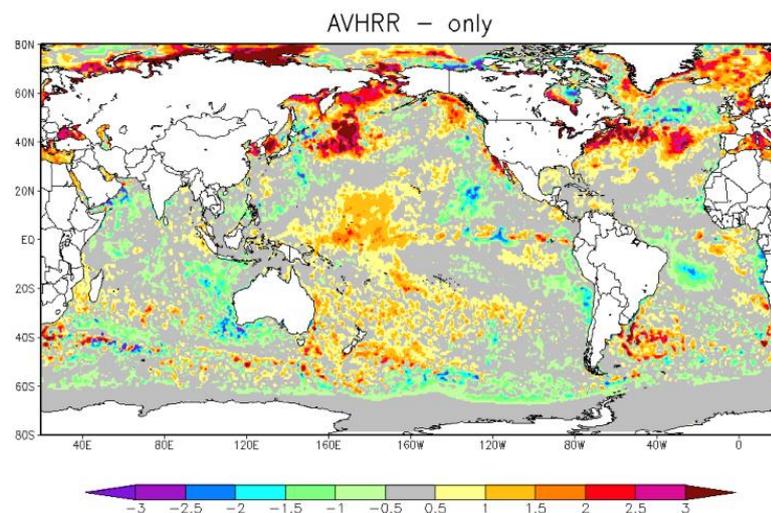
Figure 6.3 ocean energy budget estimated by Cheng et al. 2017.



Source: Cheng et al., 2017

The final figure (Figure 6.4) gives a snap-shot of the distribution of warm waters on August 18 this year. Studies of earlier events reveal high vulnerability of marine ecosystems and fisheries to such extreme climate events.

Figure 6.4 Daily OISST Anomaly intv2: 18 August 2018



Source: <https://www.ncdc.noaa.gov/oisst>

A recent study by Frölicher et al. in the prestigious science journal Nature states that today, 87 per cent of Marine heatwaves are attributable to human-induced warming, with this ratio increasing to nearly 100 per cent under any global warming scenario exceeding 2 degrees Celsius. The study results suggest that MHWs will become very frequent and extreme under global warming, probably pushing marine organisms and ecosystems to the limits of their resilience and even beyond, which could cause irreversible changes.

Food for thought

Climate change is projected to negatively impact all aspects of food security according to IPCC. Now a new study by Kasegawa and co-authors published in Nature Climate Change, states that strict policies to curb the effects of climate change could leave millions more people hungry than would a warming climate itself. In a short news notice in Nature, it is noted that in one scenario, climate change alone would result in an extra 24 million people going hungry in 2050, compared with the number expected if today's climate prevailed. When rigid policies were added, the number of hungry people jumped by a further 78 million, most of them in Africa and

South Asia. The authors say officials should consider the consequences for food availability when setting climate policies.

It seems that regardless what we do, food production is going to be more challenging in the future, so expect higher food prices.

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SEB Climate & Sustainable Finance

Christopher Flensburg

Head of Climate & Sustainable Finance

Phone: +46850623138

christopher.flensburg@seb.se

Assistant: johanna.cavallin@seb.se

Christopher Kaminker, PhD

Head of Research, Climate & Sustainable Finance; Senior Advisor, Large Corporates & Financial Institutions

Phone: +46850623095

christopher.kaminker@seb.se

Gunilla Svensson

LC&FI Marketing & Communications

Gunilla.Svensson@seb.se

This report was published on 29 July 2018.
Cut-off date for calculations was 27 July 2018, unless otherwise stated.

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