

The Low Carbon Economy

Equity Research

Key Takeaways from the Paris Agreement

Paris concludes the most ambitious climate deal since 1997

On Saturday December 12, international negotiators in Paris concluded the most important climate agreement since the Kyoto Protocol was signed in 1997. The process around the summit in Paris ultimately achieved its key goals: major advanced and emerging economies have committed to new, relatively ambitious national strategies to cut emissions and a long-term framework to review and update these plans has been agreed. We see the deal as a boost to the low carbon economy, now a fast-growing \$600 bn+ market (see our recent deep-dive: GS SUSTAIN *The Low Carbon Economy*, November 30, 2015).

It's all about the process: Binding deal, non-binding targets

The Paris Agreement does not constitute a global rulebook on emissions and key regulation will continue to be determined country-by-country, and sector-by-sector. There is no formal enforcement mechanism for the new national targets governments have set themselves. Rather, the agreement recognizes that while legal obligations to cut emissions will remain a red line for many countries, major emitters are willing to commit to increasingly ambitious emission reduction strategies. International review of these strategies will start earlier than expected in 2018, with a new round of commitments expected for 2020.

CO2 could peak around 2020 if countries stick by targets

Previous IEA modelling of the impact of the Paris commitments shows that while they slow CO2 growth, global emissions will continue to inch up towards 2030. We maintain our view that these calculations underestimate the global impact of fast-growing low carbon technologies including onshore wind and solar PV. We estimate that low carbon technologies already save ca. 1.1 Gt CO2 emissions p.a., could save >5 Gt by 2025 (vs c.32 Gt global energy-related CO2 emissions today), and could help global emissions peak earlier than expected around 2020.

Incremental positive for the Low Carbon Economy

We see the agreement as a positive for sentiment on key low carbon technologies, including solar PV, onshore wind, LEDs and hybrid and electric vehicles.

This is an abridged version of a report published on December 14, 2015.

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Key Takeaways from the Paris Agreement

After over five years of preparation and 11 days of negotiations, governments on Saturday December 12 agreed to the first substantial global climate deal since the Kyoto Protocol was signed 1997. The so-called “Paris Agreement” represents a milestone in global climate negotiations. It creates a long-term international framework for encouraging, coordinating, and successively enhancing national efforts to curb emissions and promote low carbon technologies. We see the agreement as expression of policy-makers’ long-term commitment to cutting emissions and as a positive for investor sentiment on the Low Carbon Economy (see GS SUSTAIN *The Low Carbon Economy*, Nov 30, 2015).

An ambitious global climate deal

We see the level of international ambition to cut emissions and promote low carbon technologies, which is reflected in the Paris Agreement, as incrementally higher than expected. Several provisions in the final, legally-binding 12-page Agreement – as well as in the explanatory 20-page Decision which adopts it– contain language that we believe is more ambitious than most observers expected in the run-up to the Summit. We see these enhanced ambitions reflected in several key provisions we discuss below.

The **long-term objectives of the agreement mark a step change from the previously agreed “2°C target.”** The Agreement commits countries to *“pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.”* The Decision includes additional language specifying that countries *“aim to reach global peaking of greenhouse gas emissions as soon as possible”* and *“achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.”* While this language remains vague, we view negotiators willingness to include it in the final text as clear vindication for proponents of an ambitious agreement.

Review timelines are shorter than expected, with the substantial review process beginning already in 2018, rather than post-2020 as several major emitters had demanded during the negotiations. In the Agreement, countries commit to update their commitments every five years and to a first so-called *“global stocktake”* in 2023, when countries review progress in global mitigation efforts. The Decision however clarifies that countries are expected to *“update”* their commitments by 2020, and that a first *“facilitative dialogue ... to take stock of the collective efforts”* will take place in 2018 (we interpret this as first, informal version of the global stocktake process that is defined in the agreement). Additionally, countries will also be *“invited”* to develop *“mid-century low greenhouse gas emission development strategies”* by 2020.

The Agreement **introduces a relatively comprehensive, enhanced emission and mitigation measurement and reporting framework.** Emission monitoring and reporting had been among the more contentious provisions in the negotiations draft. We see the final provisions at the upper end of the ambition scale. As part of the so-called *“enhanced transparency framework,”* emerging economies (which had been previously largely excluded from reporting requirements) will be required to provide comprehensive reporting on emissions. Only least developed countries and small island states will continue to be excluded, although the Agreement provides some *“flexibility in the implementation of the provisions”* to developing countries *“that need it in light of their capacities.”*

Crucially, the Decision clarifies that reporting on national emissions will be tied to reporting on Intended Nationally Determined Contributions (INDCs), and that **governments plan to**

harmonize baselines and reporting methodologies for both national commitments and emissions before 2020. We see major obstacles in the implementation of these provisions, as current national commitments use a variety of metrics and baselines and are often deliberately vague in their formulation. If achieved, however, harmonized reporting could become a key catalyst for further strengthening of emission reduction targets, and increase domestic and international political pressure on governments with less ambitious targets.

We see climate finance as the element of the agreement where commitments remained most cautious. The Decision reaffirms the existing goal for advanced economies to increase climate finance to \$100 bn per year by 2020. It also adds new commitments to continue to provide the same level of finance to 2025 and for countries to negotiate a post-2025 climate finance target “*from a floor of*” \$100 bn. However, the level of commitment is not mentioned in the agreement and what constitutes such climate finance remains only loosely defined in the document, although advanced economies have committed to more detailed and transparent reporting on such financing as part of the enhanced transparency framework. There is also no formal requirement for emerging economies to contribute to climate finance, as had been discussed during the negotiations.

Paris beyond the Agreement

The Paris Summit is noteworthy not only for the intergovernmental agreement it has produced, but also for a number of other initiatives that were announced on the sidelines of the event with over 40,000 delegates from 195 countries. While many of these initiatives are still in the early stages, we see them as incrementally positive for the Low Carbon Economy.

- **Mission Innovation:** At the start of this year’s Climate Summit in Paris, this global initiative was launched to accelerate public and private clean energy innovation. 20 countries are committing to double their respective clean energy research and development (R&D) investment over the next five years (about \$20 billion). These countries include the top five most populous nations – China, India, the United States, Indonesia and Brazil. Added up together, all partner countries represent more than 80% of the world’s clean energy R&D investment. (<https://www.whitehouse.gov/blog/2015/11/29/announcing-mission-innovation>).
- **Breakthrough Energy Coalition:** Along with the *Mission Innovation*, 28 global business leaders including Bill Gates, Mark Zuckerberg, Jeff Bezos and Jack Ma launched a new initiative for investing in early-stage low carbon technologies. These include “solar paint” to transform any surface into a solar panel, flow batteries to store grid-scale energy, and “solar chemical” (akin to artificial photosynthesis) to create fuel from the sun. (www.breakthroughenergycoalition.com).
- **International Solar Alliance:** Also with the onset of the climate negotiations in Paris, the International Solar Alliance (ISA) was formed. At the initiative of India’s President Modi, over 120 states are coming together to “share technology and mobilize financial resources” (Francois Hollande, President of France) to help facilitate widespread implementation of solar projects and infrastructure.
- **Zero Emission Vehicle (ZEV) Alliance:** At the initiative of California, this alliance was formed in August. At this year’s Climate Summit, eight US states, Quebec in Canada and Germany, the UK, the Netherlands and Norway pledge to make all passenger vehicle sales zero emission vehicles by 2050. As part of the agreement countries and states outline measures, such as tax breaks and government grants, to accelerate ZEV deployment.
- **Task Force on Climate-related Financial Disclosures (TCFD):** The Financial Stability Board (FSB) has announced the establishment of an industry-led disclosure task force on climate-related financial risks under the stewardship of Michael R. Bloomberg. The aim of the task force is to develop voluntary rules on carbon emissions disclosure. According to the Governor of the Bank of England Mark Carney who chairs the FSB, only about 1/3 of the top 1,000 companies currently report their carbon emissions, often using different methodologies. (<http://www.financialstabilityboard.org/2015/12/fsb-to-establish-task-force-on-climate-related-financial-disclosures/>).

The Paris Formula: Binding agreement, non-binding targets

Whereas past climate agreements have focused on trying to impose binding quotas for emission reductions (Kyoto) or work towards global carbon pricing (Copenhagen), Paris has introduced a novel, fundamentally different approach to international emission reduction efforts. This approach revolves around a 'pledge and review' process, in which countries set their own, voluntary reduction goals, which are then collectively reviewed, but not enforced.

Despite this emphasis on voluntary action, the Paris Agreement should nonetheless not be dismissed for a lack of substance. Rather, negotiators are recognizing that international legal obligations to cut emissions remain a red line to many governments, while many major emitters at the same time have increasingly ambitious emission reduction strategies. Rather than risking another negotiations breakdown similar to Copenhagen in 2009 (see box), the summit aims to catalyze national action through a more informal process.

In 2013, governments first agreed to develop so-called "Intended Nationally Determined Contributions" (INDCs) that are voluntary ('nationally determined'), non-binding ('intended'), country-by-country goals for emission reductions ('contributions'). In the run-up to the Paris Summit over 180 countries developed such INDCs with many making formal pledges to reduce emissions for the first time. While these INDCs contain significant new commitments, they collectively nonetheless fall short of the so-called 2°C target or the newly introduced 1.5°C target.

Exhibit 1: Overview of emission reduction targets pledged in INDCs by G20 countries

'Intended Nationally Determined Contributions' (INDCs) pledges by G20 countries ahead of the Paris Summit

DMs	EU	Binding target of an at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990.
	US	Intends to achieve an economy-wide target of reducing its GHG emissions by 26-28% below its 2005 level in 2025; and 'best efforts' to reduce its emissions by 28%.
	Japan	A 25.4% reduction of GHG emission compared to 2005 by 2030.
	Canada	Economy-wide target to reduce its greenhouse gas emissions by 30% below 2005 levels by 2030.
	Australia	Reduce greenhouse gas emissions by 26-28% below 2005 levels by 2030.
EMs	China	Peaking of CO ₂ emissions around 2030 and 'best efforts' to peak early; lower emissions per unit of GDP by 60-65% from 2005 level; increase share of non-fossil fuels in primary energy consumption to around 20%.
	Brazil	Reduce greenhouse gas emissions by 37% below 2005 levels in 2025.
	India	Reduce emissions intensity of GDP by 33-35% by 2030 from 2005 level; 40% of electric power installed capacity from non-fossil fuel resources by 2030.
	Russia	Limiting GHG emissions to 70-75% of 1990 levels by the year 2030 might be a long-term indicator, subject to the maximum possible account of absorbing capacity of forests.
	South Korea	Reduce GHG emissions by 37% from the business-as-usual (BAU, 850.6 MtCO ₂ eq) level by 2030 across all economic sectors.
	Mexico	Reduce GHG emissions unconditionally by 25% below BAU scenario by 2030. Net emissions peak starting from 2026; emissions intensity per unit of GDP will be reduced by around 40% from 2013 to 2030.
	Indonesia	Reduce 26% of its GHG emissions by the year 2020 and by 29-41% by 2030 compared to the business as usual (BAU) scenario.
	Turkey	Up to 21% reduction in GHG emissions from the Business as Usual (BAU) level by 2030.
	Saudi Arabia	Up to 130 mn tonnes of CO ₂ e pa by 2030 achieved through mitigation co-benefits.
	Argentina	Reduce GHG emissions by 15-30% in 2030 with respect to projected BAU emissions
	South Africa	South Africa's emissions by 2025 and 2030 will be in a range between 398 and 614 Mt CO ₂ -eq, as defined in national policy.

Source: World Resources Institute, Goldman Sachs Global Investment Research.

The focus of the negotiations in Paris has been to (a) determine how the implementation of these INDCs will be monitored and (b) to ensure that they will become progressively more ambitious over time, so that global emission reduction goals can eventually be met. The solution developed in the Paris Agreement relies essentially on a two-step process.

- 1) A “global stocktaking” exercise will review progress towards reaching global emission reductions goals and countries progress to implementing their INDCs. This review will take place every 5 years. The first full review will happen in 2023, but a less formal stock taking process (or “facilitation dialogue”) will take place in 2018.
- 2) Countries are invited to update their INDCs every 5 years in response to the reviews. The first such update will take place in 2020.

One of the challenges of the INDC process has been that targets are not easy to compare, as countries have had significant leeway in formulating their goals and have chosen different metrics and baselines. A key challenge for negotiators ahead of the 2020 update to INDCs will be trying to harmonize these commitments among countries.

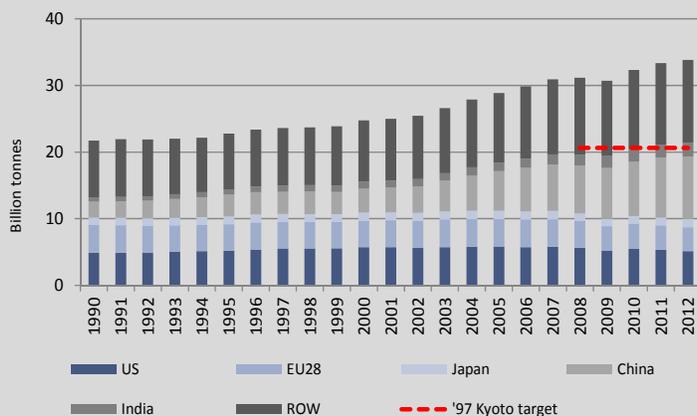
Paris in perspective – 25 years of global climate diplomacy

The significance of the 2015 UN Climate Change Conference in Paris can only be understood in the context of over a quarter century of near-continuous international negotiations on how to cut emissions. Global climate diplomacy began in earnest in 1990, with the publication of the first “Assessment Report” of the Inter-governmental Panel on Climate Change (IPCC). In response, over 150 countries signed off the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and vowed to work towards a “stabilization of greenhouse gas concentrations.” The Paris Summit was indeed “COP21”, or the 21st ‘Conference of the Parties’ – the 195 signatories of the Convention.

To implement the Convention, negotiators from 193 countries agreed in 1997 to the Kyoto Protocol, which mandated a reduction of global emissions by at least 5% compared to 1990 levels by 2008-12. The Protocol however did not succeed in reducing global emissions; by 2012 they had increased by 55% above 1990 levels. Advanced economies were slow to implement the agreement, withdrew eventually, or declined to ratify it altogether. At the same time, emissions from emerging and developing countries – which were not required to meet targets under Kyoto – tripled by 2012 from 1990 levels. China accounted for over half of this increase, and overtook the US as the largest emitter in 2005.

Exhibit 2: Kyoto targets were not met

CO2 emissions (excl. land-use change and forestry), 1990-2012



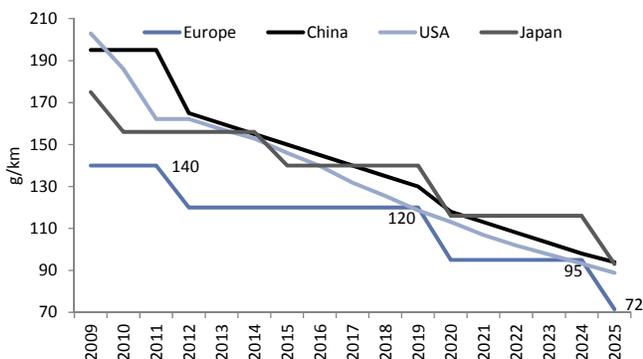
Source: World Resources Institute, Goldman Sachs Global Investment Research

In light of these shortcomings, efforts of international negotiators shifted to creating a new framework with binding commitments on advanced economies, in return for commitments by China and other major emerging economies to slow the pace of their emissions growth. The efforts ultimately failed at the Copenhagen Summit in 2009. The summit produced only an accord in which governments emphasized “strong political will to urgently combat climate change” and agreed that “deep cuts in global emissions are required.” The establishment of a Kyoto-like global framework of binding national quotas for emission reductions – the focus of global climate diplomacy for over two decades – had become increasingly unrealistic.

Despite Paris, national policy will continue to set the tone

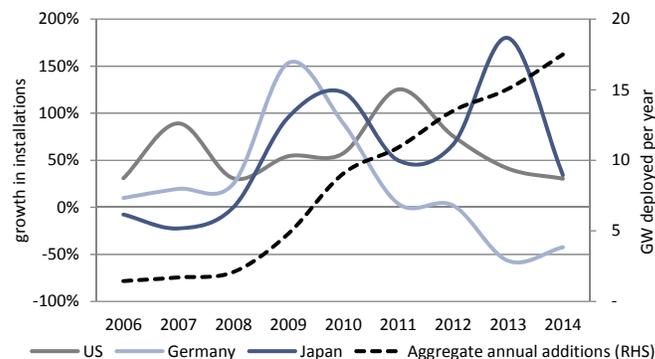
We emphasize that the Paris Agreement is not a global rulebook, and while it helps to coordinate national efforts to cut emissions and promote low carbon technologies, key regulation will remain country-by-country, and sector-by-sector (for an in-depth discussion of how emissions regulation continues to evolve, see our deep-dive, *The Low Carbon Economy*, Nov 30, 2015).

Exhibit 3: Regulatory pressure keeps increasing...
CO2 emissions (gCO2/km) regulations



Source: Japan Automobile Manufacturers Association (JAMA), US Department of Energy (DOE), Goldman Sachs Global Investment Research.

Exhibit 4: ...although it remains volatile across countries
Solar PV growth in the US, Japan, Germany, 2006-14



Source: Goldman Sachs Global Investment Research.

While we see regulatory pressure continuing to intensify in 2015-25, we expect the global policy landscape to stay fragmented and volatile, regardless of the Paris Agreement. Key incentives will continue to:

- be established at the national (and in some cases sub-national) level, rather than in multilateral negotiations. Key markets (China, EU, select US states) remain regulatory 'pressure points', with disproportionate global influence;
- be piecemeal, with incentives tied to specific sectors and technologies. Despite inherent efficiency advantages, carbon pricing is likely to remain one regulatory instrument among many, with limited coverage and relatively low price levels;
- be subject to frequent changes driven by (a) continued adjustment of policy to evolving technology and market conditions, (b) political controversy, and (c) regulatory innovation and contagion.

CO₂ could peak by 2020, if countries stick with their Paris targets

In the run up to the summit, IEA modelling suggested that under current Paris commitments ('INDC scenario'), global emissions' growth would slow but not peak before 2030. We maintain our view that these calculations underestimate the global impact of fast-growing low carbon technologies including onshore wind and solar PV. We estimate that if countries implement their current commitments, this could help global emissions peak earlier than expected, possibly as early as 2020.

The impact of the Paris Agreement on global emissions is subject to a number of key uncertainties:

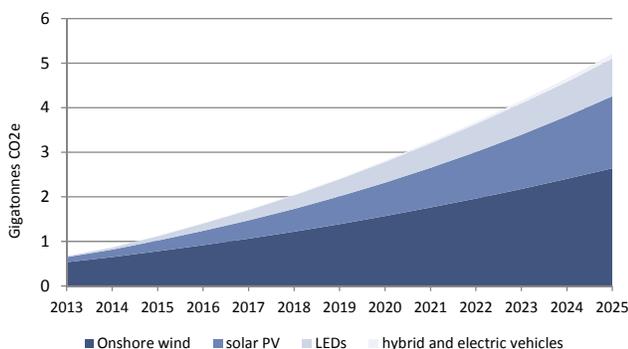
- a) It remains to be seen to what extent countries will indeed follow through on their national emission reduction commitments;
- b) Future tightening of national targets could significantly increase the long-term impact on emissions;
- c) The speed of global economic growth will continue to be a major determinant of future emissions.
- d) Fast developing low carbon technologies could change global emission pathways faster than expected.

Previous IEA modelling of the impact of the Paris commitments ("INDC scenario") shows that while they slow CO₂ growth, global emissions will continue to inch up towards 2030. While we take no view on the likelihood that countries will follow through on their commitments or how future INDCs will look, we believe that the IEA modelling and other comparable mainstream scenarios underestimate the impact of fast growing low carbon technologies.

In our recent report (GS SUSTAIN *The Low Carbon Economy*, Nov 30, 2015) we argue that low carbon technologies could indeed start to shift global emission pathways earlier and more significantly than is assumed in mainstream scenarios. As key technologies including onshore wind, solar PV, LEDs and grid-connected vehicles continue to scale, they deliver material emission savings. We estimate that the installed base for these four technologies already helps to save roughly 1.1 Gt of CO₂ emissions per year; and forecast that emission savings could increase to 5.3 Gt CO₂e per annum by 2025.

Exhibit 5: Low carbon technologies could save >5 Gt CO₂ emissions pa by 2025...

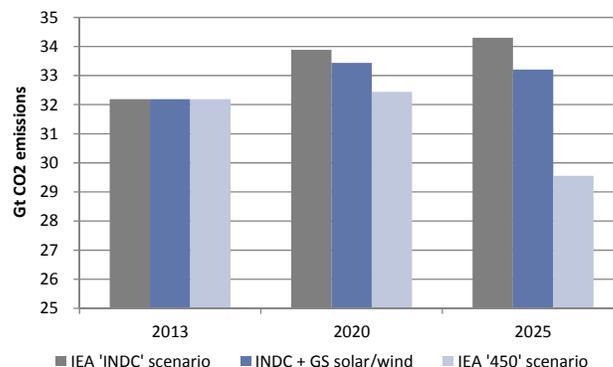
Annual emission savings from four low carbon technologies



Source: IEA, EPA, ICCT, BP, Goldman Sachs Global Investment Research.

Exhibit 6: ...and contribute to global CO₂ emissions peaking around 2020, earlier than in common scenarios

Co₂ emissions in IEA 'INDC' and '450' scenarios, and INDC scenario with our solar/wind forecasts



Source: IEA, Goldman Sachs Global Investment Research.

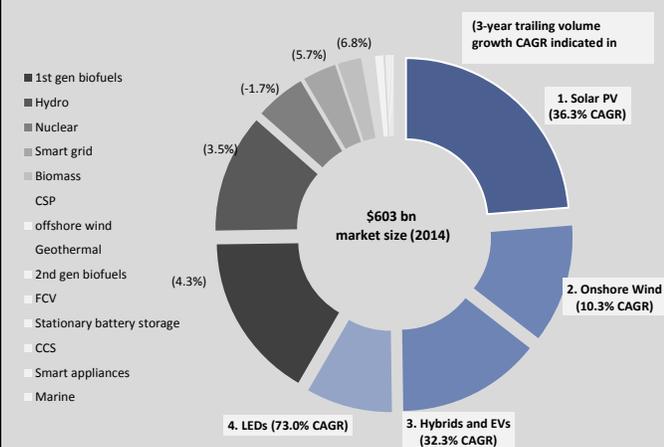
While these technologies present no ‘silver bullet’ to rein in CO2 emissions; they could help global emissions to peak around 2020 – rather than continuing to increase slowly over the next decade. We compare our projections to two IEA scenarios, the “INDC” scenario (modelled on the assumption that countries will achieve their self-set Paris targets) and the “450” scenario (assuming more ambitious policies including carbon pricing to limit emissions to levels that will keep temperature rises below 2°C).

We find that, relative to our forecast, both scenarios considerably underestimate the speed of wind power deployment (42% and 24% below our estimate by 2025 in the INDC and 450 scenarios respectively) and particularly solar power (76% and 70% below our estimates). All else equal, our solar PV and onshore wind assumptions would reduce emissions by 2025 by 8%, and contribute to an overall decline in emissions in the 2020-25 period.

Budding low carbon technologies underpin emission reductions

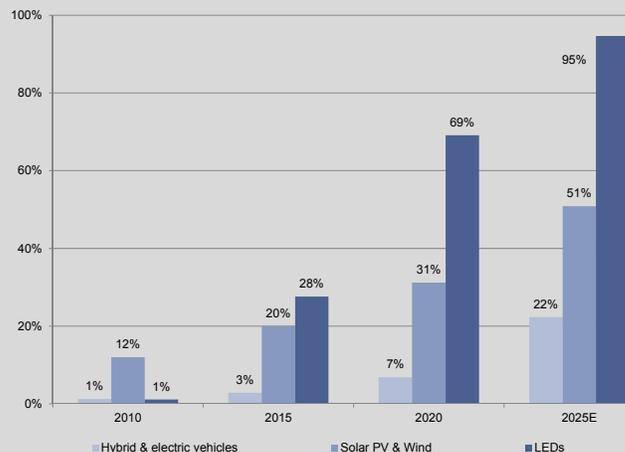
Among low carbon technologies, LEDs, onshore wind, solar PV, and hybrid & electric vehicles stand out by combining market scale (>\$10 bn pa revenue opportunity) with a consistent track record of volume growth (>10% 3y trailing CAGR). Collectively they present a set of breakthrough technologies that we expect to rapidly take market share in global lighting (69% by 2020 vs. 28% today), new power generation (51% by 2025 vs. 20% today), and autos (22% in 2025 vs. 3% today). We believe this creates not only significant emissions savings but also new commercial opportunities. Solar and wind installations are now a \$200 bn+ pa market and our analysts project grid-connected vehicle sales growing from c.\$12 bn in 2015 to \$244 bn by 2025.

Exhibit 7: Four front runners combining growth and scale dominate low carbon technologies
LCE technologies by market size and 3-year growth CAGR



Source: BP, UNEP, OECD/FAO, IHS, Advanced Energy Economy, Goldman Sachs Global Investment Research.

Exhibit 8: ...and are taking market share in autos, power generation and lighting
Market shares in autos, power generation and lighting



Source: Goldman Sachs Global Investment Research.

While these are fundamentally different technologies at various stages of their development, we see in each case similar dynamics at play: (1) Their low carbon footprint makes them key beneficiaries of regulatory incentives and attracts investment; (2) successful R&D is delivering a rapid succession of performance improvements and cost reductions; which is (3) transforming them from high-tech gadgets with niche applications into viable alternatives to incumbent technologies. This (4) drives customer acceptance and allows them to scale rapidly, which (5) in turn reinforces regulatory support and drives further cost reductions.

We believe the global impact of these technologies is still often underestimated. In our recent report (GS SUSTAIN *The Low Carbon Economy*, Nov 30, 2015) we forecast that in 2015-2020, new wind and solar installations will add the oil equivalent of 6.2 mn barrels per day (mbpd) to global energy supply. This is more than the 5.7 mbpd US shale oil production added over 2010-15.

Disclosure Appendix

Reg AC

We, Jaakko Kooroshy, Aaron Ibbotson, CFA, Derek R. Bingham, Warwick Simons, Gabriel Wilson-Otto, CFA, Justus Schirmacher, Gaurav Tandon and Juhi Malik, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

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