

More Lean, More Green

Wind and solar efficiency gains set to shift generation mix

Europe is moving toward a fundamental shift in its power generation mix faster than we previously expected. An acceleration in the pace of cost reduction for renewables, particularly from wind, puts Europe on course to no longer require subsidies after 2023 to displace legacy power sources, in our view. We estimate a 48% average annual increase in wind and solar installations through 2036, and we more than double our estimates for growth in European wind turbine revenue. Vestas, Iberdrola, Enel and Acciona are the best positioned Buy-rated companies in our coverage to exploit these changes to Europe's power generation mix.

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Table of Contents

| | |
|--|-----------|
| Our thesis in 12 charts: A burgeoning profit pool | 4 |
| PM summary | 6 |
| Cost reductions for wind/solar has been above our expectations | 8 |
| LCOE falls to continue on more efficient turbines, lower WACC | 11 |
| Renewables to be installed in Europe without subsidy from 2023 | 15 |
| €3 tn in developer investment over 20 years in solar and wind | 19 |
| How to benefit from the renewable super-cycle? | 23 |
| What does it mean for European companies? | 26 |
| European companies can afford renewables growth | 33 |
| M&A to retain a role in the wind industry | 34 |
| Risks: Competition to put pressure on returns, other technologies | 35 |
| Appendix: Lower costs to transform the business cycle | 37 |
| Disclosure Appendix | 40 |

Prices in this report are as of the close of June 2, 2017

Related Renewables Research

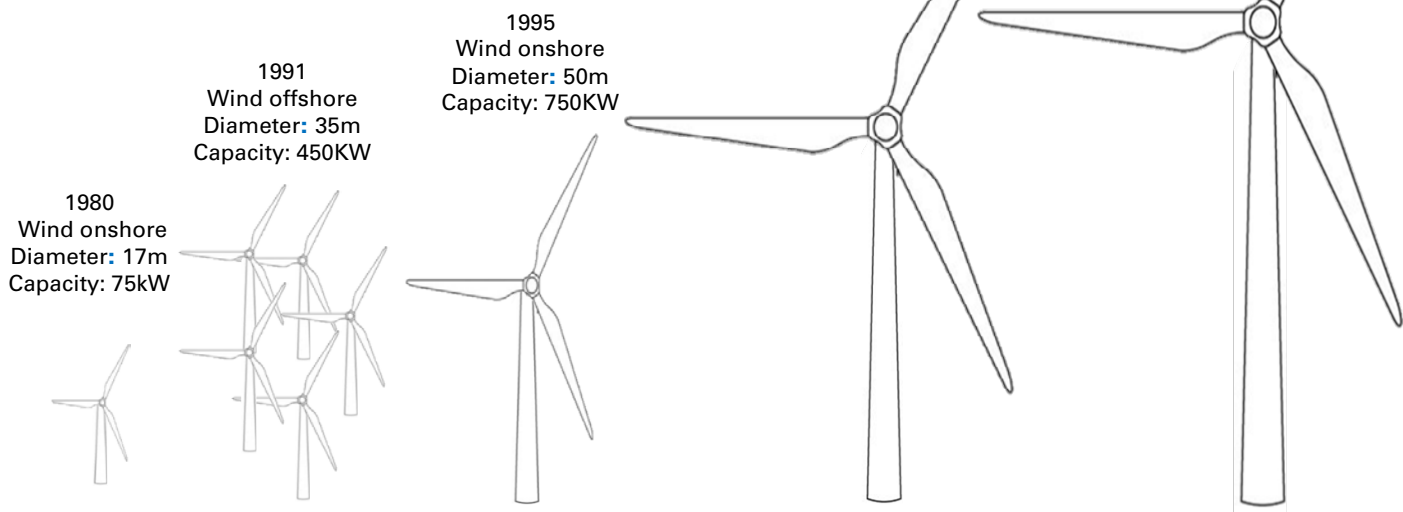
- Get a deeper dive on wind turbine manufacturers with our accompanying note, [Wind manufacturers to benefit from change in the generation mix](#).
- Visit our portal for a list of related research on [The Low Carbon Economy](#).
- Also, see our note on [The Power Shift](#) in Europe, the main thesis of which sees European utilities returning to earnings growth.



More Lean, More Green in numbers

For wind turbines, bigger is better

The size of turbines has increased significantly over the last 30 years. We expect this trend to continue, implying more efficient turbines, which would in turn mean more electricity output from wind farms. (p. 12)



Wind and solar costs crater...

c.60% Decline in the levelized cost of energy (LCOE) since 2009 according to our estimates. (p. 8)

c.37% Our estimate of the decline in the LCOE by 2026. (p. 8)

...spurring a boom in investment

c.€3,000,000,000,000

Global investment in wind and solar over the next 20 years, according to our new estimates (€3 tn). (p. 19)

Scaling up

c.350 GW The amount of wind investment we see in Europe over the next 20 years. (p. 22)

c.630 GW What we see in Asia over the same time horizon. (p. 22)

Winds of change

2020 The date at which we expect the cost of wind generation to be below the wholesale power price in Iberia, Italy and the UK. (p. 15)

2023 When we expect wind costs to be below power prices in France and Germany. (p. 15)

How the profits might be shared

c.€200 bn

Profit pool for renewables manufacturers over the next 20 years, according to our estimates. (p. 23)

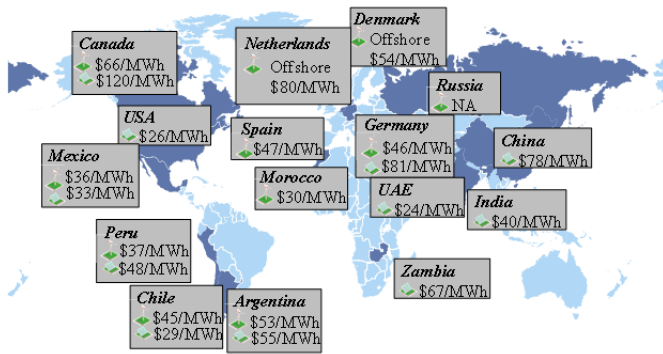
c.€825 bn

Profits accruing to developers for the same period, according to our model. (p. 23)

Our thesis in 12 charts: A burgeoning profit pool

Exhibit 1: Recent wind/solar auctions for new projects have been closed at surprisingly low prices

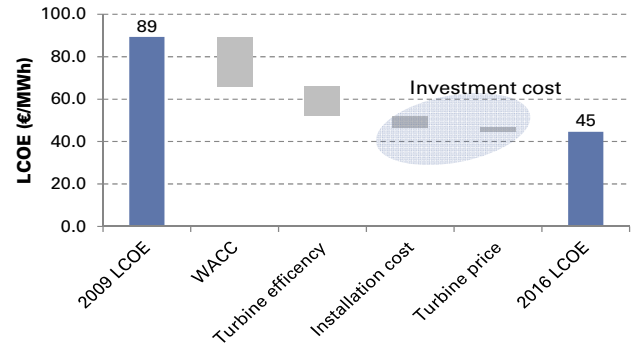
Lowest price auctions recorded in solar/wind industry



Source: IEA, Goldman Sachs Global Investment Research.

Exhibit 2: Wind power costs have fallen by c.50% over the last seven years, partially owing to better turbines

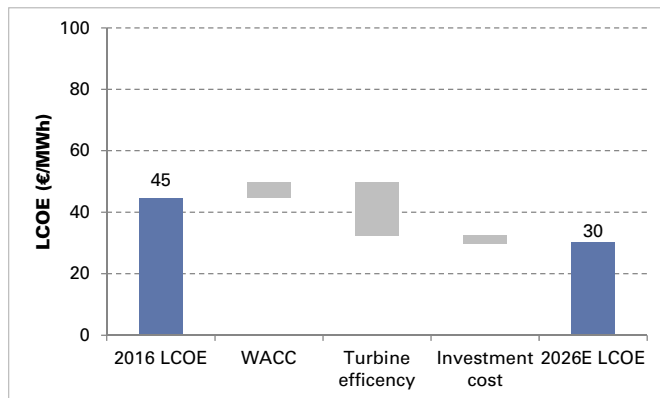
LCOE for wind



Source: Goldman Sachs Global Investment Research.

Exhibit 3: We expect wind costs to fall by a further 33% over the next 10 years, as turbine efficiency improves...

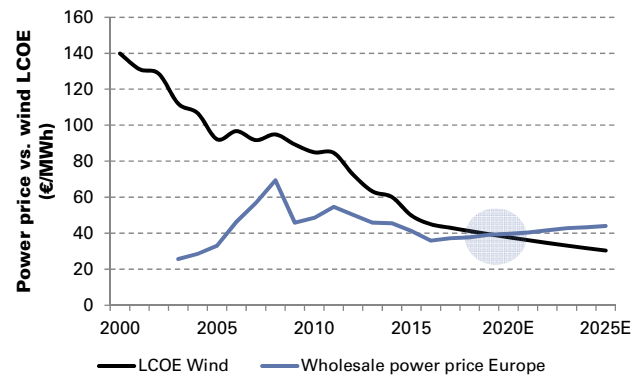
LCOE for wind



Source: Goldman Sachs Global Investment Research.

Exhibit 4: ...taking costs below the wholesale power price in Europe in the early 2020s

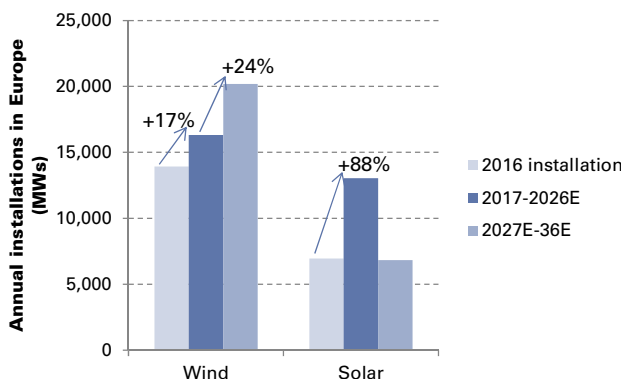
Costs for wind vs. wholesale power price - Europe



Source: Goldman Sachs Global Investment Research.

Exhibit 5: As costs for wind/solar fall below power prices, we expect annual installations to increase

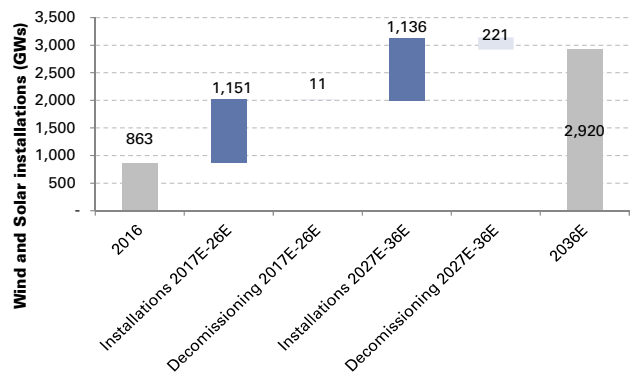
Annual installations, wind/solar (global)



Source: Goldman Sachs Global Investment Research.

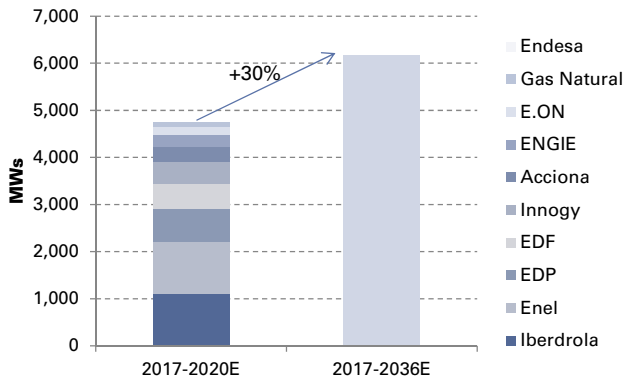
Exhibit 6: We expect wind/solar installations to more than triple over the next 20 years

Wind/solar accumulated installations (global)



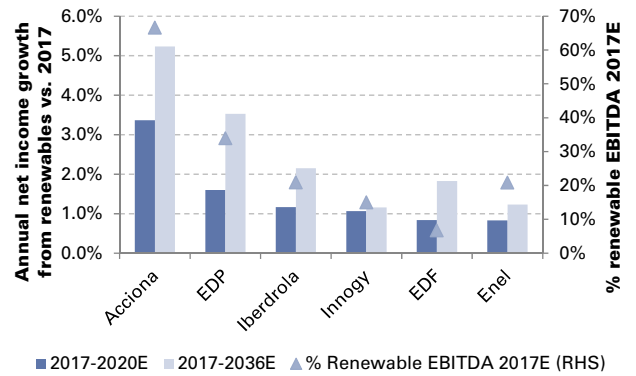
Source: Goldman Sachs Global Investment Research.

Exhibit 7: We expect developers to increase renewable installations by 30% pa on average vs. current run-rate...
Annual renewable installations, MWs, key Euro developers



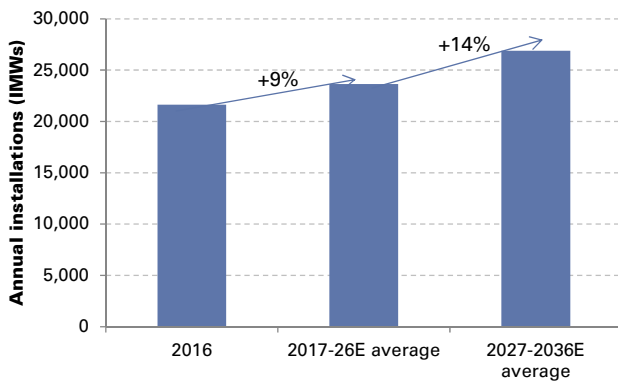
Source: Goldman Sachs Global Investment Research.

Exhibit 8:accelerating net income from renewables to a 2.5% 2017-36E CAGR on average (vs. 1.5% currently)
Net income growth from renewables



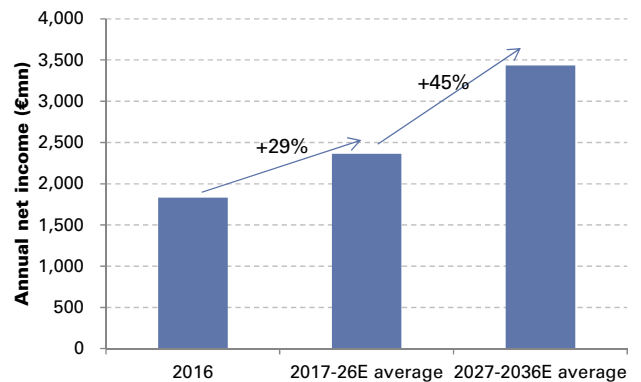
Source: Goldman Sachs Global Investment Research.

Exhibit 9: We expect wind manufacturers under coverage to benefit as annual installations increase by 24%...
Annual installations - European wind manufacturers



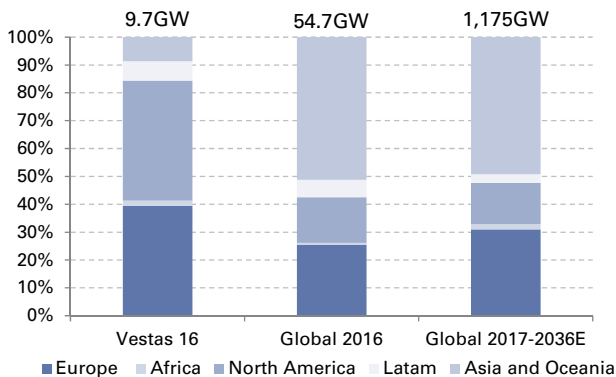
Source: Goldman Sachs Global Investment Research.

Exhibit 10: and annual net income increases by 88%
Annual net income – European wind manufacturers



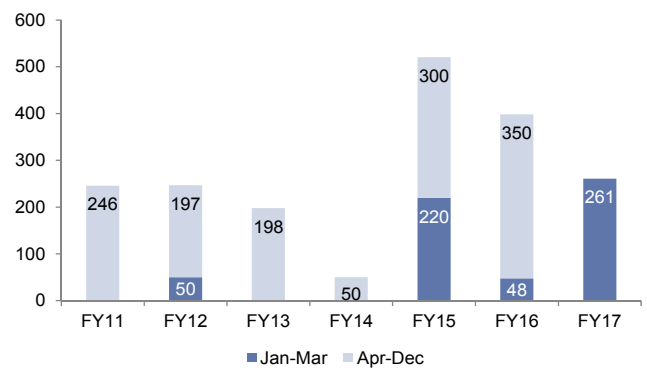
Source: Goldman Sachs Global Investment Research.

Exhibit 11: Vestas remains our top pick among wind manufacturers given its scale and geographical....
Geographical installations – Vestas vs. global installations



Source: Goldman Sachs Global Investment Research.

Exhibit 12: ...diversification, which continues growing with increased effort to penetrate the Chinese market
Order intake in China - Vestas



Source: Goldman Sachs Global Investment Research.

PM summary

As highlighted in “Power Shift” (September 2016), we expect the need to decarbonize economies, in combination with improved economics, to fuel a capex super-cycle for utilities in renewables and grids. In this report, **we conclude that capex for renewables is likely to be higher than we previously anticipated**, given a significant reduction in costs for solar/wind, and an improvement in the efficiency of these technologies.

Cost reductions for wind/solar have been above expectations

At the last renewable auctions, we saw a significant acceleration in the cost reduction of wind/solar around the world (Exhibit 1). We estimate that the costs of wind and solar have decreased by c.60% on average over the last seven years, driven by more efficient turbines, lower investment costs, and a lower cost of capital. We expect this trend to continue and forecast costs falling by c.37% on average over the next eight years (Exhibits 2 and 3).

We expect this cost reduction to continue, and to boost wind/solar installations over the next decade, significantly changing the current generation mix, and sooner than we previously anticipated.

Global footprint to widen, capex to reach €3 tn over 20 years

As wind/solar costs continue to fall, we expect this to drive a widening of the global footprint for renewable installations. We expect the worldwide installed capacity of wind/solar to triple/quintuple (Exhibits 5 and 6) over the next 20 years. We estimate that this, together with repowering, will create a capex opportunity of €3 tn (2.3 times the market cap of the MSCI global utilities index), with new installations (ex-repowering) focused on Asia (54%), Europe (25%) and the US/Canada (15%).

As costs fall below power prices, European installations should climb

We expect the costs of wind and solar to fall below the level of European power prices in the early 2020s (Exhibit 4). As costs fall below the price of the marginal technology, we expect utilities to ramp up their renewables installations, to keep/gain market share in the generation mix. We expect this to significantly change the generation mix in Europe, and would expect thermal technologies (mainly coal and gas) to be negatively impacted in terms of output. We would expect most governments (aside from those keen to protect a particular technology, such as domestic coal) to support this, as it should help reduce carbon emissions and lower electricity tariffs.

Profits for wind developers/manufacturers to accelerate

We estimate that the reduction in costs for wind/solar that we forecast will trigger a 30% step-up in annual global renewables investment (MWs) globally, post 2020, for the main European developers (Exhibit 7). We expect this trend to accelerate net income growth to c.2.5% (2017-36E) from 1.5% currently (Exhibit 8).

For the European wind turbine manufacturers, we expect an average step-up in annual revenues of c.17% globally over 2017-36E, vs. 2017E (9 pp higher than previously anticipated), boosting annual net income by 58%. We estimate that this will support an equity value c.15% higher than we previously anticipated for the manufacturers.

Our forecasts assume a significant change in the generation mix only in Europe: therefore, we would see upside to our renewables estimates if we were to extrapolate this globally.

Buy large European developers/manufacturers: Vestas, Enel and Iberdrola are the best positioned companies in our coverage

We see scale as a key competitive advantage for developers and manufacturers and therefore highlight Vestas, Enel and Iberdrola as key ideas to invest in the renewable growth theme.

Enel (Buy; on the Conviction List)

We are Buy-rated on Enel, given its high-single digit EPS growth, supported by continued infrastructure capex on renewables and grids. On our forecasts, Enel trades at a c.30% discount to the sector on 2018E P/E, while offering a 6.3% 2018E dividend yield. Further, assuming a re-leveraging to 3.25x-3.50x, at the low end of the peer group, we estimate that Enel could gear up its balance sheet by >€10 bn, which could allow a large buyback programme, or accelerate growth via acquisitions.

Iberdrola (Buy)

We are Buy-rated on Iberdrola, reflecting our better-than-peer earnings growth expectations, stemming from the company's higher earnings targets (6% EBITDA CAGR through 2017-20), driven by accelerated capex in low-risk, quality infrastructure activities. With a 2018E P/E of c.14.7x, we view Iberdrola's valuation as attractive in the context of infrastructure assets. Further, we expect its dividends to grow at 5% CAGR, yielding 5.3% by 2020E.

Vestas (Buy)

We see Vestas as best positioned among the European wind turbine manufacturers to benefit from industry growth prospects, owing to economies of scale and stronger cash flows than peers (supporting R&D investment). The group's low level of outsourcing supports a higher margin than peers, and an absence of M&A integration should help the group focus on reducing costs. Vestas trades at c.30% discount to peers on 2018E P/E, while offering c.4% points higher 2018E FCF yield post capex.

For more details please see our note Europe: Clean Energy: Wind: Wind manufacturers to benefit from change in the generation mix, published June 5, 2017.

Exhibit 13: Summary of ratings, 12-month price targets and valuation metrics

Enel, Iberdrola, Vestas vs. peers and capital goods average

| Stock | Rating | Price Target | Share Price 2-Jun-2017 | Upside to Price Target | EV/EBITDA | | | | P/E | | | | Dividend yield | | | | FCF yield (post capex, pre dividends) | | | |
|-----------------------------------|--------|--------------|---------------------------|------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|----------------|-------------|-------------|-------------|---------------------------------------|-------------|-------------|-------------|
| | | | | | 2017E | 2018E | 2019E | 2020E | 2017E | 2018E | 2019E | 2020E | 2017E | 2018E | 2019E | 2020E | 2017E | 2018E | 2019E | 2020E |
| Enel | B* | 5.50 | 4.73 | 16% | 6.5 | 6.4 | 6.3 | 6.2 | 12.6 | 11.2 | 10.3 | 10.1 | 5.2% | 6.3% | 6.8% | 6.9% | 5.9% | 6.2% | 8.7% | 8.7% |
| Iberdrola | B | 7.5 | 7.1 | 4% | 9.7 | 9.1 | 8.6 | 8.3 | 16.7 | 14.7 | 13.2 | 12.4 | 4.6% | 4.8% | 5.0% | 5.3% | 2.5% | 2.5% | 2.5% | 2.5% |
| Utilities Average | | | | -1% | 8.5 | 8.4 | 8.3 | 8.1 | 16.1 | 15.8 | 15.0 | 14.1 | 4.6% | 4.7% | 5.1% | 5.4% | 3.2% | 4.1% | 5.2% | 6.1% |
| Vestas (DKR) | B | 730 | 574 | 27% | 6.7 | 6.3 | 5.5 | 4.6 | 14.1 | 13.5 | 12.1 | 9.2 | 2.0% | 2.1% | 2.4% | 3.1% | 6.5% | 6.2% | 7.3% | 10.2% |
| Wind Manufacturers Average | | | | 14% | 7.1 | 6.7 | 6.1 | 5.7 | 17.8 | 18.8 | 16.0 | 11.6 | 2.3% | 2.4% | 2.7% | 3.4% | 8.2% | 2.3% | 3.8% | 3.6% |
| Cap Goods Average | | | | | 12.5 | 11.7 | 11.0 | 10.4 | 20.1 | 18.5 | 17.2 | 16.2 | 2.5% | 2.7% | 2.7% | 2.9% | 5.0% | 5.5% | 6.0% | 6.3% |

Rating: B - Buy, S - Sell, N - Neutral ; * Denotes Conviction List Membership

All price targets are for 12-months and price targets and share price are expressed in €, unless otherwise stated.

Source: FactSet, Goldman Sachs Global Investment Research

Cost reductions for wind/solar has been above our expectations

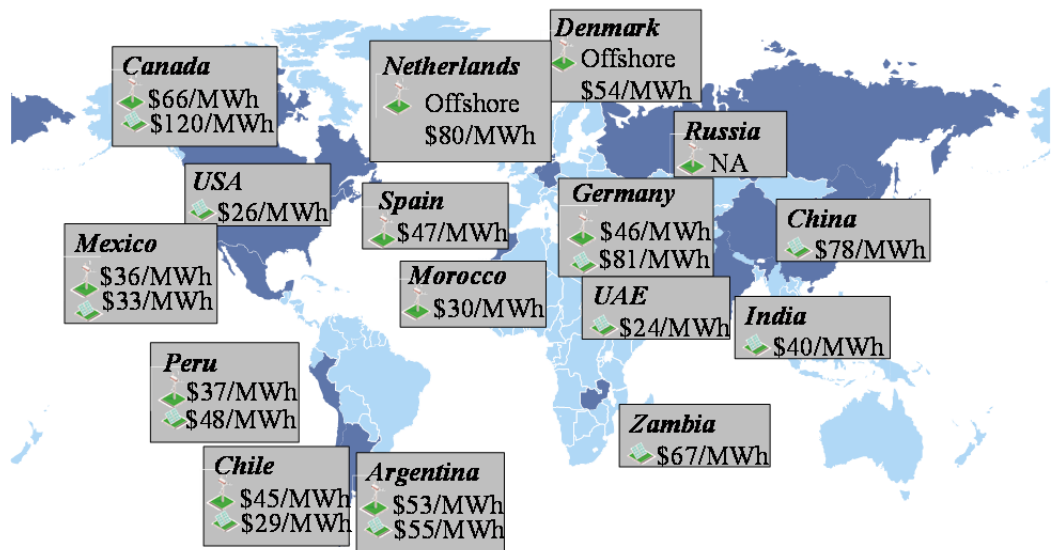
The low price achieved in recent renewables auctions worldwide implies a significant acceleration in cost reduction for wind/solar. We estimate that the costs of these technologies has decreased by c.60% on average over the last seven years, making wind/solar the cheapest way of producing electricity. We believe that there is still significant room for further cost reduction, and expect a further c.37% decrease in costs over the next eight years.

Prices achieved by wind/solar in recent auctions have been surprisingly low...

We see the outcome from the recent auctions (Exhibit 14) for wind and solar as solid evidence of the improvement in the competitiveness of these technologies, with prices of c.US\$30/MWh in different countries, e.g. Morocco, the United Arab Emirates, Mexico, Chile and the US (in the US, wind and solar are awarded with tax benefits on top of the achieved price in the auction).

Exhibit 14: The low achieved prices in renewable auctions worldwide implies a significant acceleration in cost reduction

Lowest auctions recorded in solar/wind industry



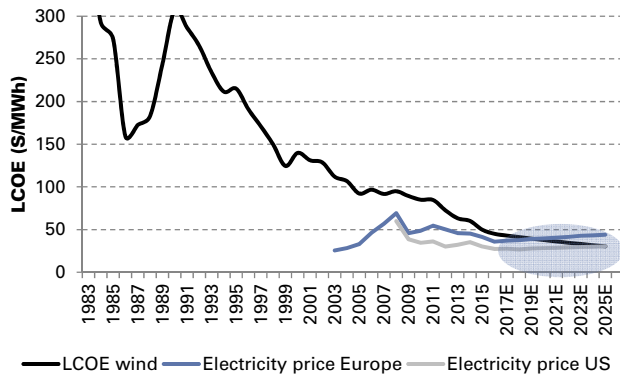
Source: IEA and Goldman Sachs Global Investment Research.

...implying a significant reduction in costs for these technologies

We estimate that the wind and solar levelized cost of energy (LCOE) has decreased by c.50% and 70% respectively since 2009. We expect this trend to continue and (based on IRENA's forecasts for investment costs and our expectation of more efficient turbines and the evolution of cost of capital) estimate a c.33%/43% reduction in LCOE for wind/solar over 2017-25 (Exhibits 15-16)

Exhibit 15: We estimate that costs have decreased by 50%/70% for wind/solar through 2009-16...

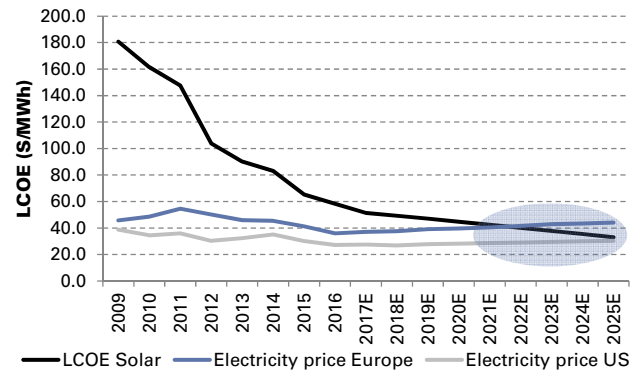
Wind – LCOE vs. electricity prices



Source: Goldman Sachs Global Investment Research.

Exhibit 16: ...and we expect costs to continue falling by 33%/43% over the period 2016-25

Solar – LCOE vs. electricity prices



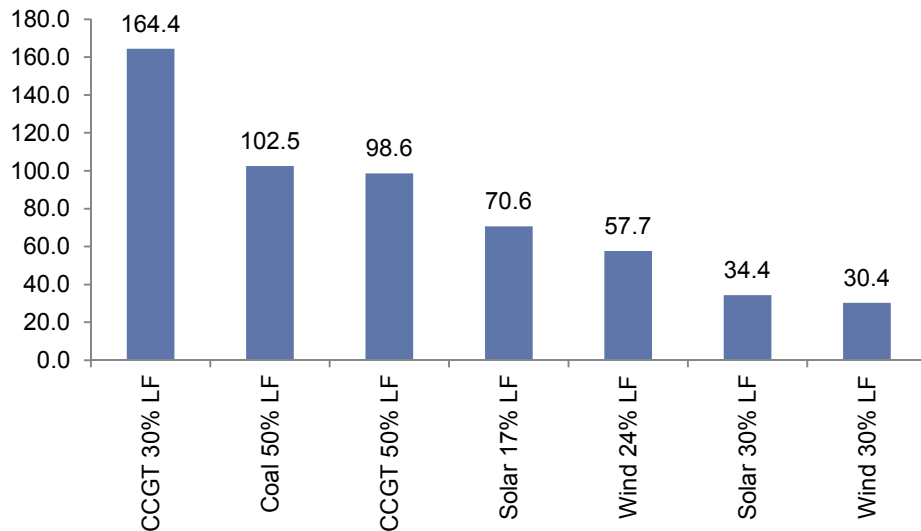
Source: Goldman Sachs Global Investment Research.

Wind and solar are currently the cheapest ways of producing electricity when all costs (including investment) are included

We estimate that the reduction in LCOE for wind/solar has made these technologies the cheapest way of producing electricity when all the costs, including investment costs, are taken into account (Exhibit 17).

Exhibit 17: Wind and solar are currently the cheapest way of producing electricity when investment costs are taken into account

LCOE – wind and solar vs. other technologies (US\$/MWh)



Source: Goldman Sachs Global Investment Research.

Economics to be an increasingly important driver of renewable installations

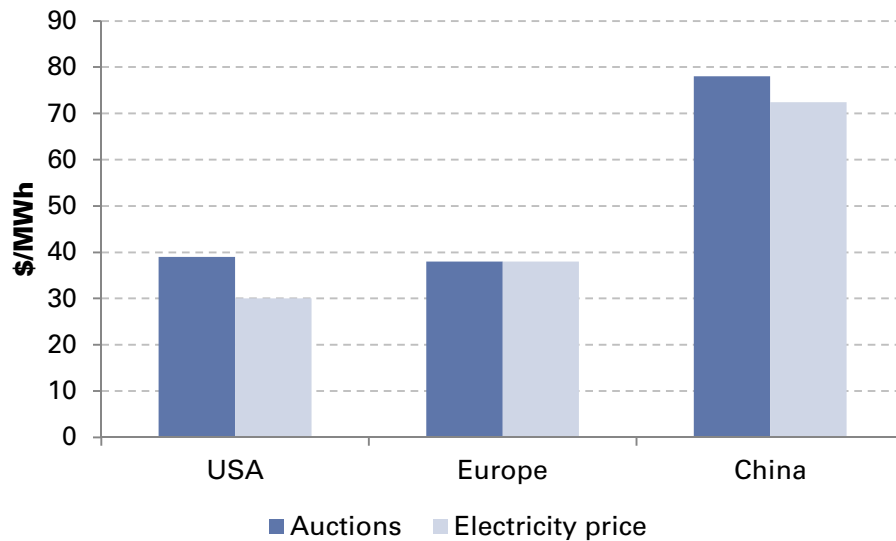
Installations of renewables are currently driven primarily by:

- Environmental measures:** Requirements to reduce carbon emissions have prompted governments to create regulatory frameworks to incentivize renewable installations in regions where new power plants are not driven by economics. This is the main driver of renewable installations in countries with over-capacity, such as Europe and the US. Although wind/solar are the cheapest ways of producing electricity, their costs are still above/in-line (Exhibit 18) with the power prices in these countries, as most of the thermal power plants in these countries are achieving returns well below their cost of capital (their only aim is to cover variable costs; hence, investment cost is not considered as it is a sunk cost).
- Economics:** In countries with tight capacity, either as a result of old power plants or growth in electricity demand, wind/solar installation is driven by economics (this applies mainly to emerging markets).

We expect this economic driver to become increasingly significant over the coming years, as wind/solar cost reduction continues.

Exhibit 18: The achieved price for wind/solar has almost reached parity with the electricity price

Wind/solar achieved price vs. power prices



Source: Goldman Sachs Global Investment Research.

LCOE falls to continue on more efficient turbines, lower WACC

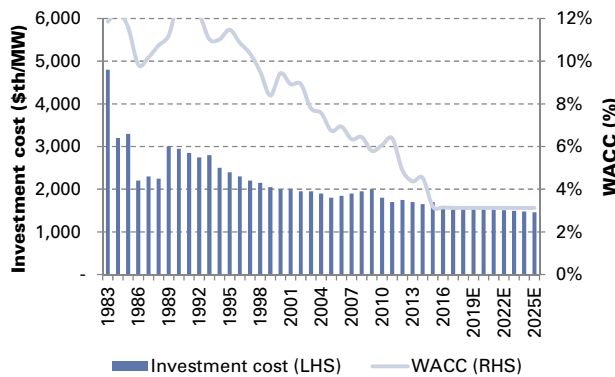
The reduction in LCOE has been mainly driven by lower investment costs (mainly solar), a lower cost of capital and more efficient wind turbines. Going forward, we expect the reduction in investment cost and increased efficiency to continue lowering the costs of these technologies.

Wind's LCOE fall was driven by efficiency improvements and a lower WACC

The reduction in the LCOE of wind has been mainly driven by a significant improvement in the efficiency of turbines. As per Exhibits 19, 20 and 21, the load factor (working hours) of new turbines has continued to increase since 1980, despite the newer turbines usually being in sites with lower winds (developers usually locate the turbines in the best sites, and hence, (excluding repowering) newer turbines typically have lower wind resources). In addition to efficiency improvement, we see a reduction in the cost of capital as a key driver.

Exhibit 19: The reduction in the LCOE of wind has been mainly driven by a reduction in WACC...

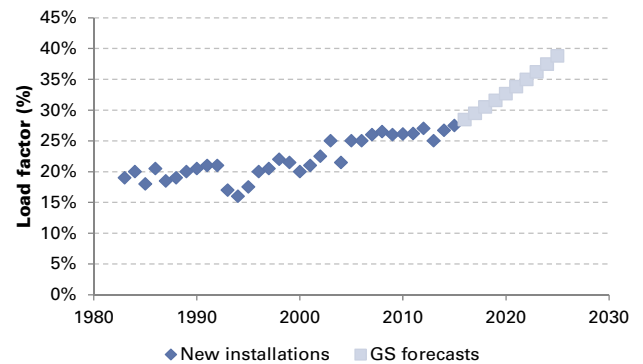
Wind – investment cost and WACC



Source: IRENA and Goldman Sachs Global Investment Research.

Exhibit 20: ...and an improvement in the efficiency of the turbines

Wind – load factor evolution

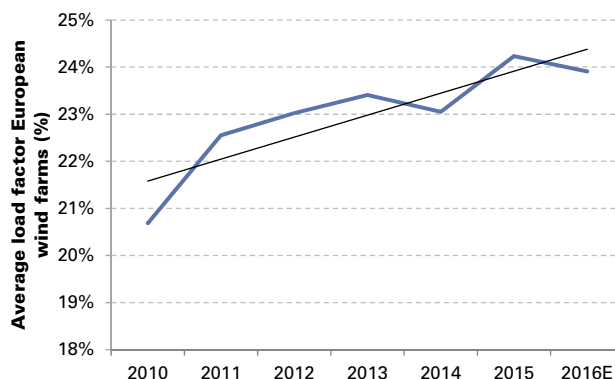


Source: IRENA and Goldman Sachs Global Investment Research.

The improvement in the load factor of wind farms can be seen in Europe (Exhibits 21 and 22).

Exhibit 21: Despite new wind farms usually being in sites with lower wind resources, the load factors of wind farms in Europe have been increasing...

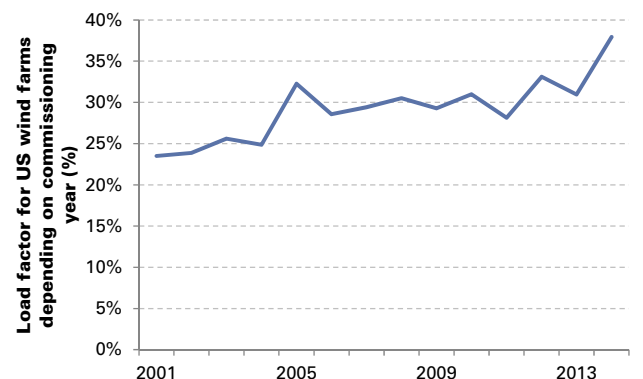
Wind – average load factor in Europe



Source: ENTSOE, RTE and BNETZA and Goldman Sachs Global Investment Research.

Exhibit 22: ...as they have in the US

Wind – average load factor in US depending on commissioning year



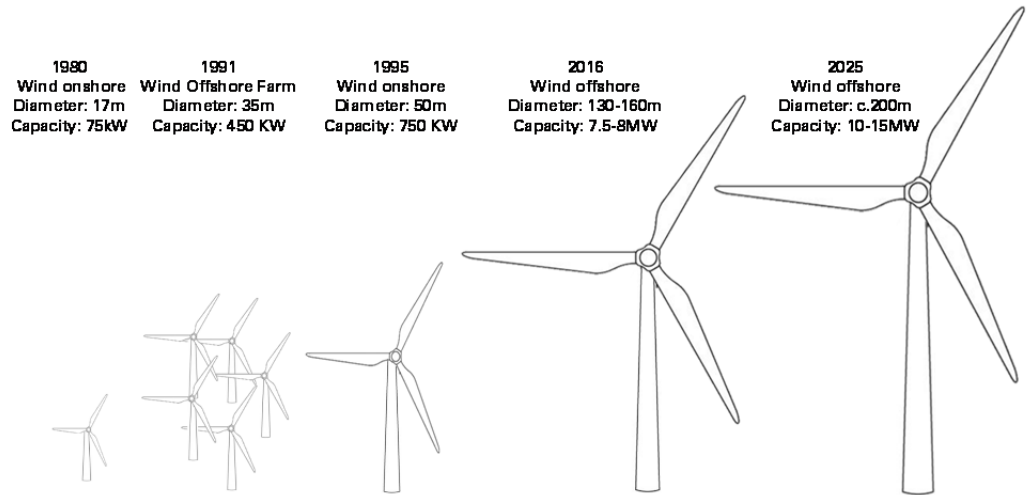
Source: SNL Financial.

The improvement in the load factor has been mainly driven by larger and more efficient blades, which are able to capture more energy from the wind. As seen in the below formula, the power that can be captured by a wind turbine depends on the wind speed (v) and the air density (ρ) which are given for a particular site. Additionally, the power varies with the square of the size of the blade (l) which has been increasing historically.

$$P = \frac{8}{27} * \rho * v^3 * \pi * l^2$$

Exhibit 23: The size of turbines has increased significantly over the last 30 years; we expect this trend to continue, implying more efficient turbines which will increase the electricity output from a specific site.

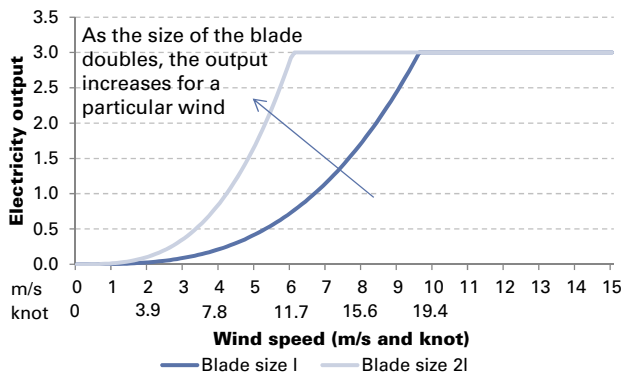
Size evolution of wind turbines



Source: Goldman Sachs Global Investment Research.

The load factor of a wind turbine depends on the energy captured by the turbine and the maximum power that the generator is able to produce. Therefore, theoretically, for a particular site the load factor (the ratio of energy produced to the maximum output of the generator) would increase as the size of the blade increases (implying more energy is captured) and/or the capacity of the generator decreases (implying lower maximum output).

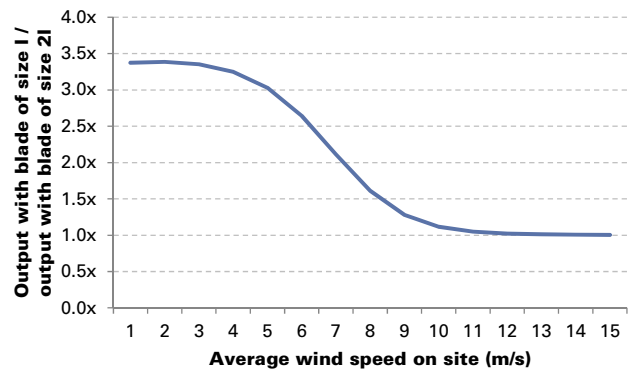
Exhibit 24: As the size of the turbine doubles, the electricity output increases for lower wind speeds...
Impact on electricity output when the size of the blade doubles as a function of wind speed



Source: Goldman Sachs Global Investment Research.

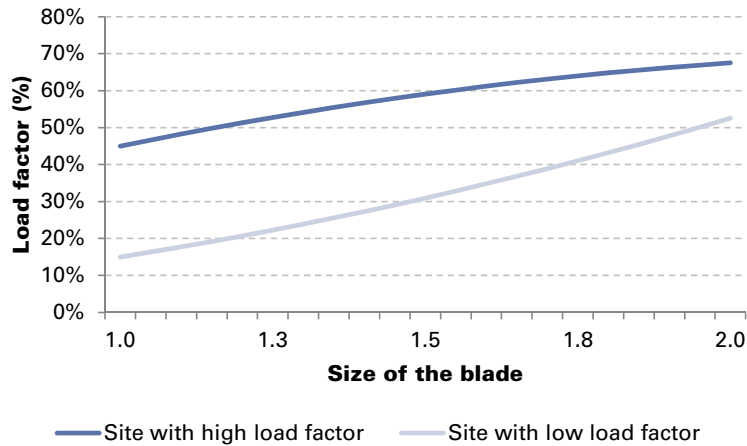
Exhibit 25: ...implying higher load factors for a given site (Exhibit for illustrative purposes)

Load factor impact when the size of the blade doubles for a particular site as a function of average wind speed



Source: Goldman Sachs Global Investment Research.

Exhibit 26: As the size of the blade increases, the load factor of a site improves. The impact is higher for sites with low average wind speed (Exhibit for illustrative purposes)
Load factor vs. size of the blade

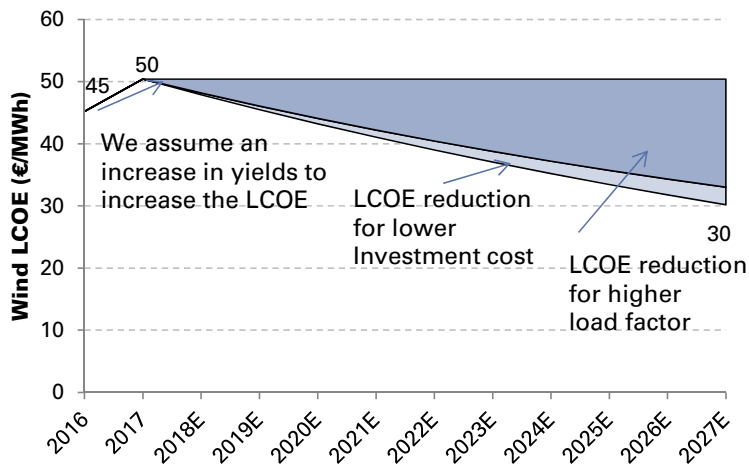


Source: Goldman Sachs Global Investment Research.

We expect the LCOE of wind to continue to fall, mainly driven by more efficient and larger wind turbines, rather than a lower price.

Exhibit 27: We expect the reduction in the LCOE of wind to be driven mainly by more efficient turbines

Wind LCOE – drivers of the reduction we forecast



Source: Goldman Sachs Global Investment Research.

Exhibit 28: Our forecasts of LCOE assume an increase in the cost of capital

Assumptions in terms of returns

| Currently | |
|--------------------|------|
| Risk free rate | 1% |
| Market premium | 5% |
| Beta | 1 |
| Cost of debt | 1% |
| Tax rate | 30% |
| Debt/(Debt+Equity) | 80% |
| Forward | |
| Risk free rate | 2.5% |
| Market premium | 5% |
| Beta | 1 |
| Cost of debt | 2.5% |
| Tax rate | 30% |
| Debt/(Debt+Equity) | 80% |

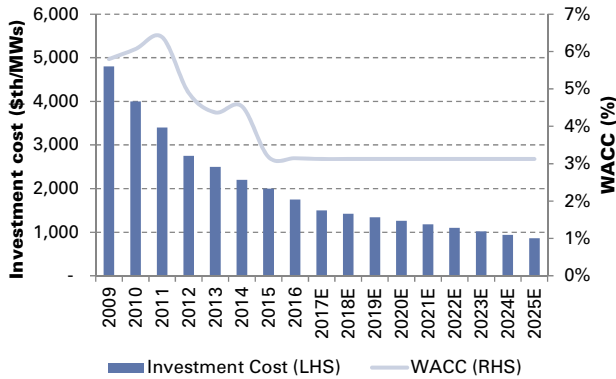
Source: Goldman Sachs Global Investment Research.

Solar LCOE drop has been driven by lower investment cost and WACC

For solar, we see the installation cost and the reduction in the cost of capital as the main drivers of a lower LCOE.

Exhibit 29: The reduction in the LCOE of solar has been driven mainly by a reduction in WACC...

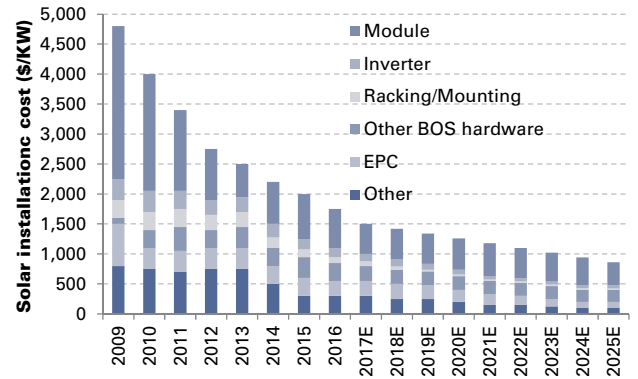
Solar – investment cost and WACC



Source: IRENA and Goldman Sachs Global Investment Research.

Exhibit 30: ...and a significant decrease in the installation cost

Solar – breakdown of investment cost reduction

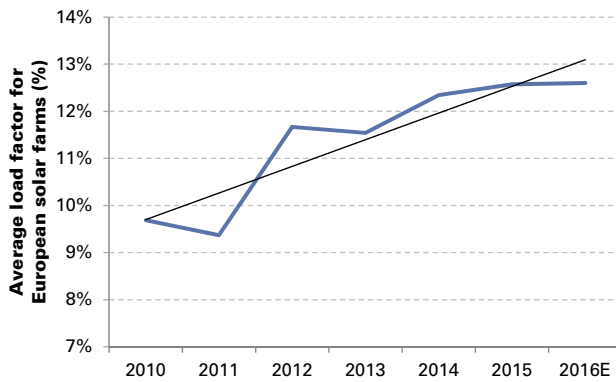


Source: IRENA.

Although the reduction in investment cost has been the main driver of lower solar costs, we highlight that, as in the case of wind, the average load factor for solar panels has been increasing, mainly driven, in our view, by more efficient panels.

Exhibit 31: Solar panel load factors have been rising...

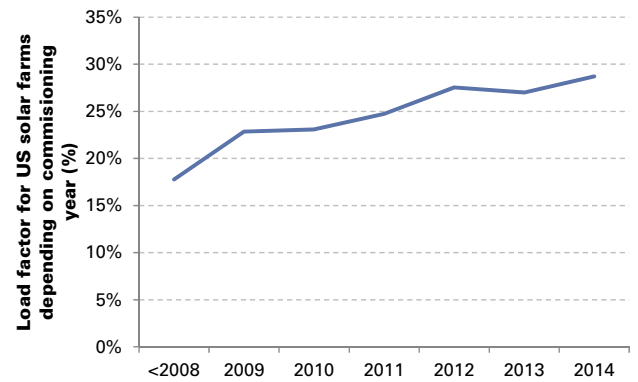
Solar – average load factor in Europe



Source: ENTSOE, RTE and BNETZA and Goldman Sachs Global Investment Research.

Exhibit 32: in Europe and the US

Solar – average load factor in US depending on commissioning year



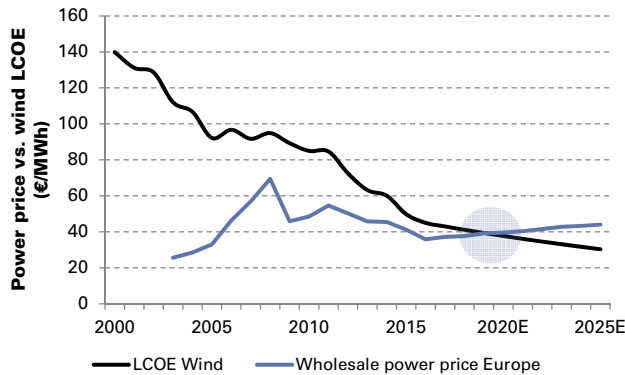
Source: SNL Financial.

Renewables to be installed in Europe without subsidy from 2023

As a result of the reduction in costs for wind and solar that we expect, we believe that these energy sources will require no subsidy in Europe from 2023. We estimate that this will boost installations (we estimate a 48% increase in annual wind/solar installations on average over 2017-2036 vs. 2016), and implies a reduction in thermal output.

Exhibit 33: We expect wind and solar to be installed in Europe over the next decade...

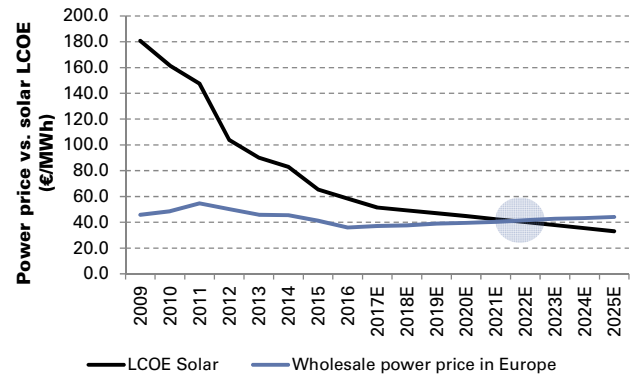
Required power price for wind to be profitable in Europe vs. power prices



Source: Bloomberg, Goldman Sachs Global Investment Research.

Exhibit 34: ...without subsidies, owing to a strong reduction in costs

Required power price for solar to be profitable in Europe vs. power prices



Source: Bloomberg, Goldman Sachs Global Investment Research.

We expect two main impacts:

- **Wind/solar installations to increase significantly:** We estimate that wind/solar annual installations over the period 2017-2036 could increase by 53%/43% (48% on average), vs. 2016.
- **Coal and gas power plants will lose market share:** We would expect the increase of wind and solar installations to negatively impact the market share of coal and gas power plants.

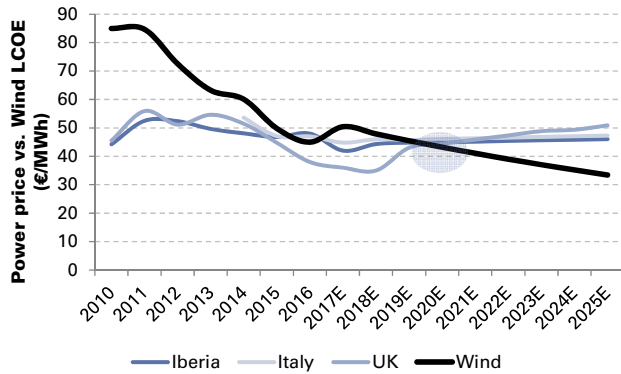
Wind to be competitive in Iberia, Italy and the UK from 2020E...

...and in Germany and France from 2023E

We expect wind costs to be below power prices in Europe from 2023

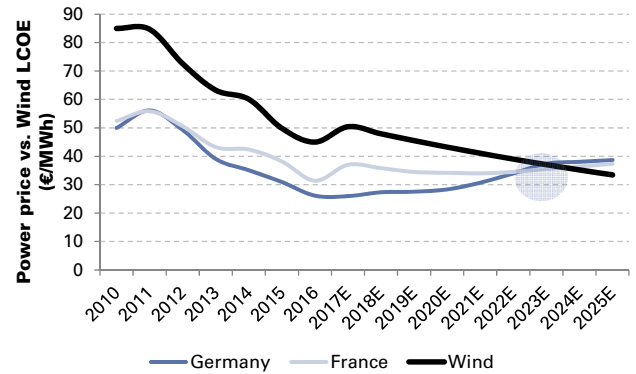
We expect the reduction in the cost of wind generation to imply that its cost will be below the wholesale power price in Iberia, Italy, and the UK from 2020, and below the power price in France and Germany from 2023.

Exhibit 35: We expect the cost of wind to be below the power price in Iberia, Italy and the UK from 2020E...
 LCOE of wind vs. wholesale power price forecast (€/MWh)



Source: Goldman Sachs Global Investment Research.

Exhibit 36: ...and below the wholesale power price in France and Germany from 2023E
 LCOE of wind vs. wholesale power price forecast (€/MWh)



Source: Goldman Sachs Global Investment Research.

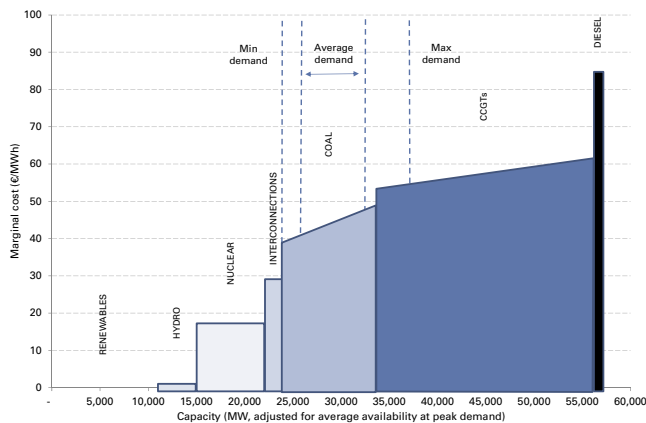
We expect this to boost wind installations

As the costs of wind/solar fall below the marginal cost in the wholesale power price, we expect investments in renewables to pick up. Assuming that governments have no interest in supporting a particular domestic technology, we would expect government support, as higher wind installations would imply lower carbon emissions and lower electricity tariffs.

As wind/solar installations increase, thermal technologies (gas and coal) should lose share in the generation mix (Exhibits 37 and 38). Therefore, we would expect utilities to invest in renewables to gain/maintain their market share in the generation business.

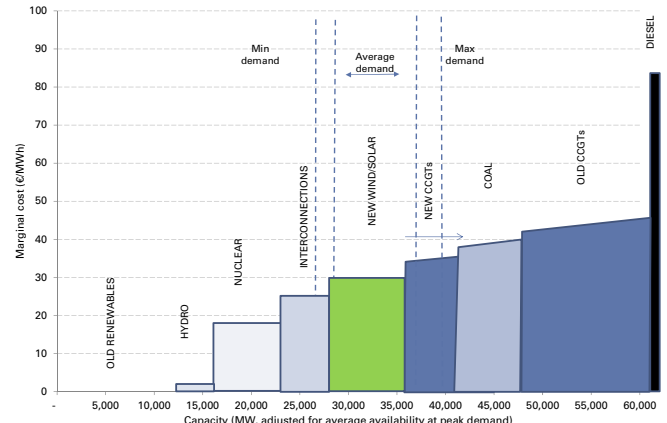
As a bull case, we assume that by 2030 the minimum load factor for CCGTs will be 15%-20% (to cover lack of wind and solar output), and that there will be no output from coal power plants (for economic considerations). Additionally, we assume that the cost of solar will be in line with the cost of wind (meaning that both technologies should gain the same share in the generation mix), and that both technologies will have significantly improved efficiency (a c.42% load factor for wind and 30% for solar).

Exhibit 37: We expect new wind/solar to displace ...
 Illustrative merit order - current



Source: Goldman Sachs Global Investment Research.

Exhibit 38: ...thermal technologies from the merit order
 Illustrative merit order - forward



Source: Goldman Sachs Global Investment Research.

Exhibit 39 shows our calculation of potential wind/solar installations in Germany.

Exhibit 39: We would expect wind/solar installations to reach 123/98 GW by 2030 in Germany as their costs fall below the wholesale power price for these technologies, impacting the market share of coal and gas power plants
 Upside potential for wind/solar installations in 2030 based on these technologies having costs below the wholesale power price

| Output (TWh) | 2016 | 2017E | 2018E | ... | .. | .. | 2030E | Wind/solar installations 2030E Bull case for bull case | Bull case for wind/solar | %change |
|--------------|------------|------------|------------|-----|----|----|------------|--|--------------------------|---------|
| Total | 607 | 604 | 603 | ... | .. | .. | 590 | | 590 | |
| Hydro | 31 | 31 | 31 | ... | .. | .. | 32 | | 32 | |
| Nuclear | 82 | 72 | 72 | ... | .. | .. | - | | - | |
| Coal | 279 | 268 | 253 | ... | .. | .. | 115 | | - | |
| Gas | 39 | 39 | 39 | ... | .. | .. | 124 | | 45 | |
| Wind | 78 | 93 | 106 | ... | .. | .. | 198 | 97 | 295 | |
| Solar | 35 | 38 | 40 | ... | .. | .. | 53 | 97 | 150 | |
| Other | 62 | 62 | 62 | ... | .. | .. | 68 | | 68 | |

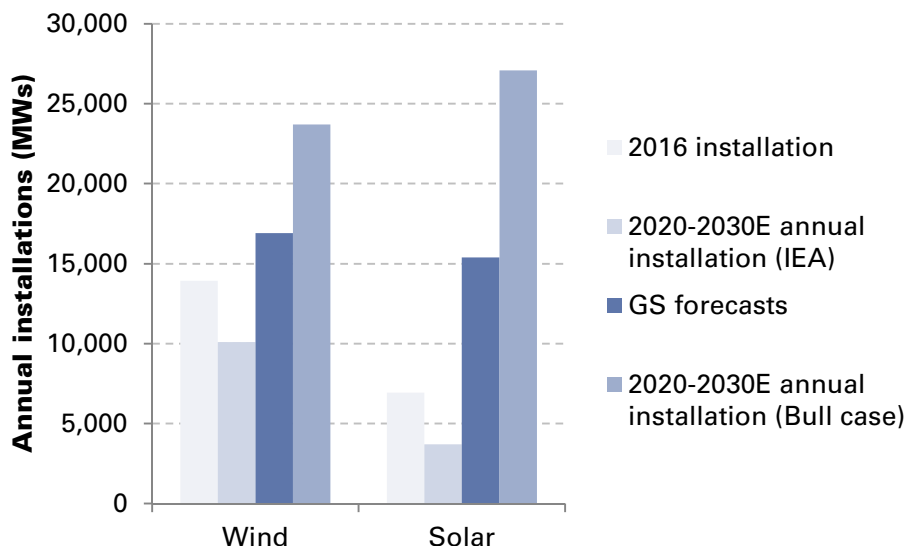
| Load factor | 2016 | 2017E | 2018E | ... | .. | .. | 2030E | Load factor |
|--------------|------------|------------|------------|-----|----|----|-------|-------------|
| Total | 33% | 32% | 31% | ... | .. | .. | | |
| Hydro | 24% | 24% | 24% | ... | .. | .. | 24% | 24% |
| Nuclear | 87% | 87% | 87% | ... | .. | .. | n.a. | |
| Coal | 65% | 65% | 63% | ... | .. | .. | 48% | 0% |
| Gas | 15% | 15% | 15% | ... | .. | .. | 48% | 18% |
| Wind | 18% | 19% | 20% | ... | .. | .. | 23% | 42% |
| Solar | 10% | 10% | 10% | ... | .. | .. | 10% | 30% |
| Other | 42% | 42% | 43% | ... | .. | .. | 45% | 45% |

| Capacity MW | 2016E | 2017E | 2018E | ... | .. | .. | 2030E | Additional MWs | Capacity MW |
|--------------|----------------|----------------|----------------|-----|----|----|----------------|----------------|----------------|
| Total | 211,218 | 216,979 | 223,213 | ... | .. | .. | 247,433 | | |
| Hydro | 14,981 | 14,981 | 14,981 | ... | .. | .. | 15,341 | | 15,341 |
| Nuclear | 10,800 | 9,516 | 9,516 | ... | .. | .. | - | | - |
| Coal+Lignite | 49,258 | 47,071 | 46,121 | ... | .. | .. | 27,672 | | 27,672 |
| Gas | 29,900 | 29,833 | 29,401 | ... | .. | .. | 29,391 | | 29,391 |
| Wind | 49,168 | 56,158 | 61,308 | ... | .. | .. | 97,118 | 26,367 | 123,485 |
| Solar | 40,332 | 42,832 | 45,332 | ... | .. | .. | 60,832 | 36,913 | 97,745 |
| Others | 16,779 | 16,588 | 16,554 | ... | .. | .. | 17,079 | | 17,079 |

Source: Goldman Sachs Global Investment Research.

Extrapolating this approach to the rest of Europe, we estimate wind/solar annual installations could reach c.25.5 GW/30.2 GW on average over 2020-2030, +70%/+290% vs. 2016 installations. However, and conservatively, we assume wind/solar annual installations grow 21%/121% vs. 2016 installations over 2020-2030 (the mid-point between the EIA outlook and our bull case). The rationale for this is to reflect potential regulatory risk (governments could limit renewable growth to protect domestic coal for example).

Exhibit 40: We estimate that the cost reduction of solar and wind will boost annual installations in Europe for wind/solar by 21%/121% respectively over 2020-2030, vs. 2016 Annual installations – Europe



Source: Company data, IEA, Goldman Sachs Global Investment Research.

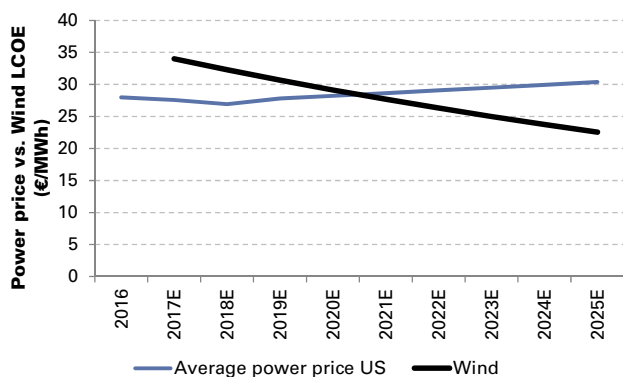
We see upside risk in the US and Latam

We believe that the improvement of wind and solar competitiveness vs. other power plants could be mirrored in other regions such as Latam and the US, which would provide upside risk to our forecasts for installations.

For the US, we assume wind and solar drive the coal load factor to 0%, and that the CCGT load factor remains unchanged at c.30%. We assume a 50% load factor for new wind installations and 30% for new solar installations, and estimate annual wind/solar installations increasing by 130%/90%.

Exhibit 41: We expect wind to be installed without subsidies in the US over the next decade

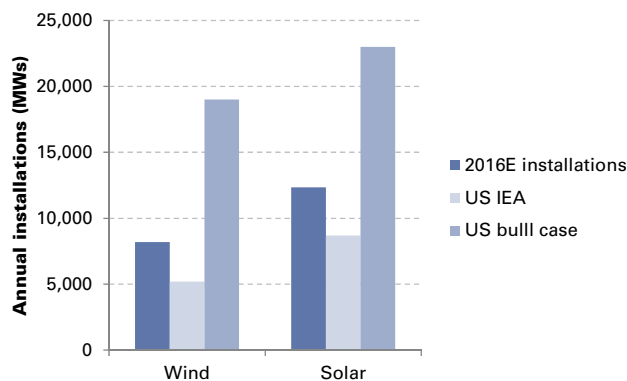
LCOE for wind vs. average wholesale power price in the US



Source: Goldman Sachs Global Investment Research.

Exhibit 42: If we were to see wind/solar substituting all the coal in the US, we estimate that annual installations would increase by c.100% for wind and solar vs. 2016

Wind and solar installations in the US, 2016 vs. IEA (base case) vs. bull case

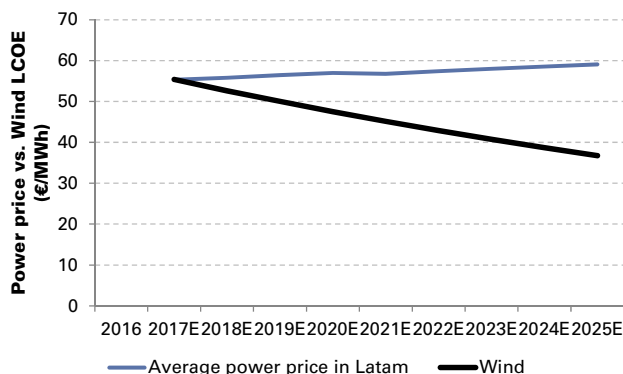


Source: Company data, IEA, Goldman Sachs Global Investment Research.

As per Exhibit 43, we believe that wind is already competitive in Latam regions, owing to its strong wind resources. In a bull case, and assuming that wind/solar installations drive the coal load factor to 0% and the CCGT load factor to c.18% (similar to Europe), we would expect solar installations to increase by c.100% vs. 2016 installations (wind would be in line with the current level).

Exhibit 43: We expect wind to be installed without subsidies in Latam over the next decade

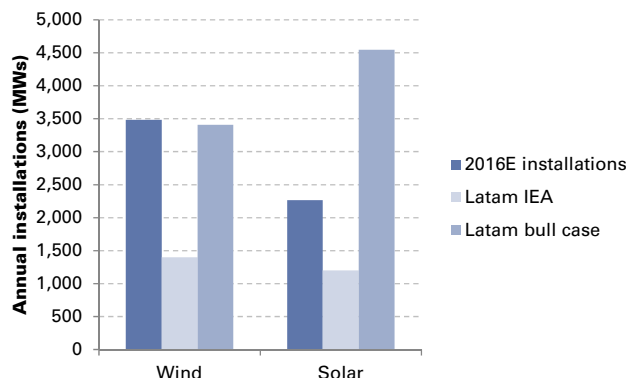
LCOE for wind vs. average wholesale power price in LatAm



Source: Goldman Sachs Global Investment Research.

Exhibit 44: If we were to see wind/solar substitute all coal and part of the CCGTs in Latam, we estimate that annual installations would rise c.100% for solar vs. 2016

Wind and solar installations in LatAm 2016 vs. IEA (base case) vs. bull case



Source: Company data, IEA, Goldman Sachs Global Investment Research.

€3 tn in developer investment over 20 years in solar and wind

We have introduced new estimates for wind/solar installations post 2020. We expect a reduction in the cost of these technologies to widen the footprint of renewable investments. We estimate c.€3 tn of investment in wind/solar over the next 20 years (2.3 times the market cap of the MSCI global utilities index). We expect wind installed capacity to triple over the next 20 years, implying c.€1.7 tn of investment. For solar, we expect installed capacity to quintuple over the period, implying €1.3 tn of investment for developers.

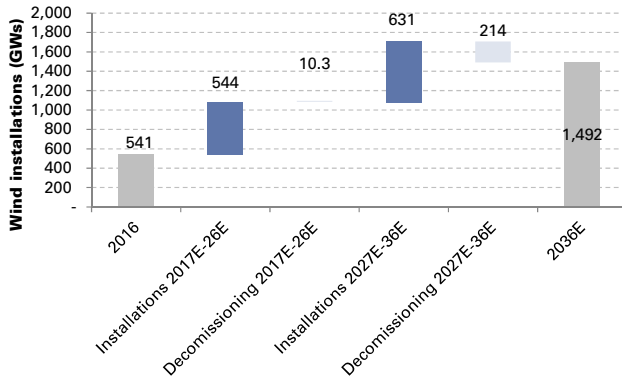
Wind/solar installations to triple/quintuple current installed base over 20 years

Over the next 20 years, we expect 1.2 TW of new installations in wind (vs. the 0.5TW current capacity) to drive global wind capacity to 1.5TW (we expect 0.2TW of wind assets to be decommissioned, Exhibit 45). This implies a three-fold increase of the current capacity of wind. For wind, we expect repowering to begin to play an important role over the next 20 years (we estimate repowering will account for c.20% of the total installations). For further details on repowering see "Repowering & O&M drive upside risks to growth expectations; January 9, 2017".

For solar, we expect 1.1TW of new installations (vs. 0.3TW of capacity currently) to drive global capacity to 1.4 TW (Exhibit 46). This implies a five-fold increase of the current installed base in solar.

Exhibit 45: Over the next 20 years, we expect wind's installed base to almost triple

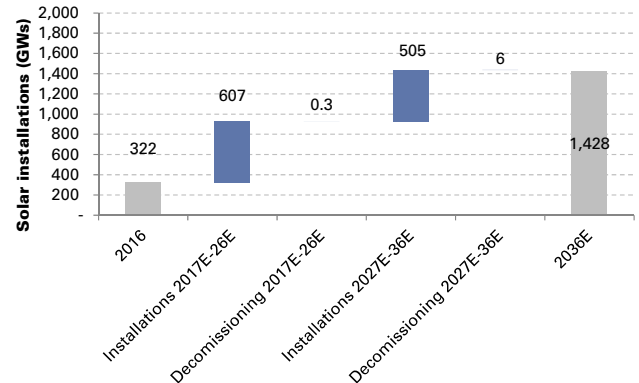
Wind – installations over the next 20 years



Source: Goldman Sachs Global Investment Research.

Exhibit 46: Over the next 20 years, we expect the solar installed base to almost quintuple

Solar – installations over the next 20 years



Source: Goldman Sachs Global Investment Research.

Our estimates are based on Goldman Sachs wind and solar forecasts over the period 2017-20. For the period 2021-2036, we take forecasts from the International Energy Agency for every region excluding Europe, where we expect installations to overtake IEA forecasts given lower costs (we assume that wind/solar installations will be at the mid-point between our bull case and IEA forecasts; Exhibit 40).

We expect wind/solar installations to drive €3 tn of investment

We estimate wind and solar installations will drive c.€3 tn of investments globally over the next 20 years.

Assuming a multiple of €1.4 mn/MW for wind, we estimate that the 1.2TW in installations would represent c.€1.6 tn in investment in wind over the next 20 years. The €1.4mn/MW is a blended multiple of wind onshore (€1.2-1.3 mn/MW) and wind offshore (€2.8-€3.2 mn/MW). We see downside risk to our estimates if prices for wind onshore and offshore decrease as part of the reduction in the LCOE. However, we expect most of the LCOE of wind to be driven by more efficient turbines, rather than cheaper prices.

Assuming a multiple of €1.1 mn/MW for solar, we estimate the 1.1 TW in installations would represent c.€1.3 tn in investments in solar globally over the next 20 years. As in the case of wind, we see downside risk to our estimates if prices for solar decrease.

Exhibit 47: We estimate installations in wind and solar imply c.€3 bn of investment over the next 20 years

Wind and solar – required investment for installations over the next 20 years

| | Wind | Solar | Total |
|---------------------|-------|-------|-------|
| Installations (GWs) | 1,175 | 1,112 | 2,287 |
| Multiple (€mn/MW) | 1.40 | 1.15 | |
| Capex (€tn) | 1.6 | 1.3 | 2.9 |
| of which repowering | 19% | 1% | |

Source: Goldman Sachs Global Investment Research.

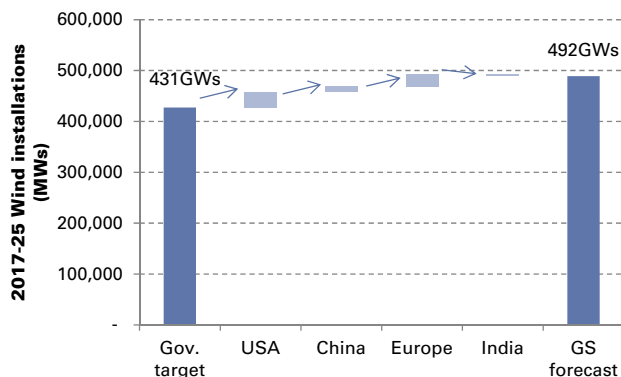
We highlight that growth expectations have been accelerating over recent years (the IEA has been raising its renewable expectations) and therefore we see upside risk to our forecasts, based on economics.

Renewable installations to surpass current government targets

We have compared our wind/solar forecasts with government targets for China, the EU, the US and India (arguably the four main economies for renewable installations over the next decade). We assume annual installations over the period 2017-25 in line with those needed to reach government targets. We conclude that our forecasts are above government targets for the US, China and Europe and lower for India, for solar and wind.

Exhibit 48: We are above targets in the US, China and Europe and below in India for wind

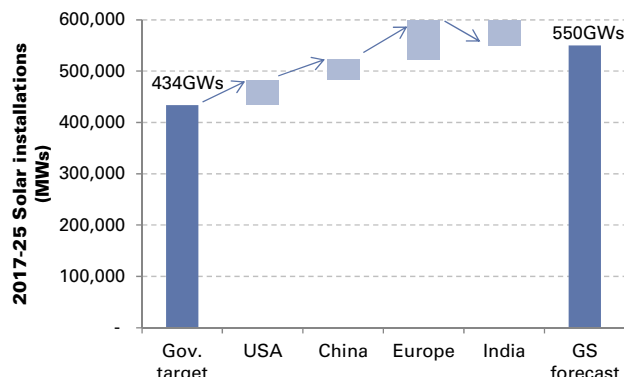
Wind – upside/(downside) to our forecasts (MWs/year) based on government targets



Source: Government targets and Goldman Sachs Global Investment Research.

Exhibit 49: We are above targets in the US, China and Europe and below in India for solar

Solar – upside/(downside) to our forecasts (MWs/year) based on government targets



Source: Government targets and Goldman Sachs Global Investment Research.

Main targets

- **European Union:** Reaching 27% of energy from renewables by 2030.
- **US:** Renewable targets on a per state basis (RPS). See *We see a future for wind in the US post-election, November 30, 2016* for further detail.
- **India:** Aiming for installed capacity of 100GW solar and 60GW wind by 2022.
- **China:** Aiming for installed capacity of 210 MWs in wind and 128 MWs in solar by 2020.

Exhibit 50: Our forecasts for wind and solar installations...

Wind – government targets vs. our forecasts

| Country | Target | Time frame | Implied MWs | GS forecasts |
|---------|---------------------------------------|------------|-------------|--------------|
| EU | 27% of energy from renewables by 2030 | 2017-2030 | 166,336 | 204,095 |
| US | Renewable targets per state (RPS) | 2017-2025 | 34,000 | 64,000 |
| India | 60 GW of wind by 2022 | 2017-2022 | 31,300 | 28,700 |
| China | 210 GW wind by 2020 | 2017-2020 | 42,000 | 47,000 |

Source: Government targets and Goldman Sachs Global Investment Research.

Exhibit 51: ... are above government's targets

Solar – government targets vs. our forecasts

| Country | Target | Time frame | Implied MWs | Forecasts |
|---------|---------------------------------------|------------|-------------|-----------|
| EU | 27% of energy from renewables by 2030 | 2017-2030 | 75,158 | 207,725 |
| US | Renewable targets per state (RPS) | 2017-2025 | 36,000 | 84,350 |
| India | 100 GW of solar by 2022 | 2017-2022 | 91,000 | 52,500 |
| China | 110 GW solar by 2020 | 2017-2020 | 32,600 | 50,600 |

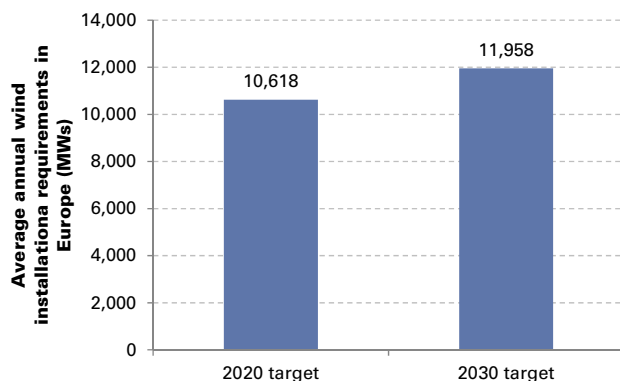
Source: Government targets and Goldman Sachs Global Investment Research.

We expect governments to continue raising renewable targets, implying an acceleration of installations

We believe that our view on renewable installations surpassing government's targets is supported by the historical track record. Excluding China (where the government reduced its renewables target at the end of 2016), most regions have been raising their targets, implying an acceleration of installations (Exhibits 52 and 53 for upgrades in the EU and the US to meet 2030 targets and RPS requirements).

Exhibit 52: Required annual installations for wind would be 10.6GW to meet 2020 targets vs. 12GW to meet 2030 targets

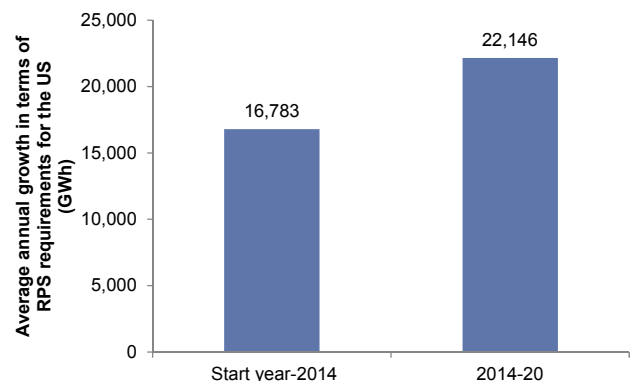
Average annual wind installations Europe to meet renewable targets



Source: EWEA and UE.

Exhibit 53: The average annual increase in installations to meet RPS in the US has been increasing.

Average annual renewable volumes in the US to meet RPS targets



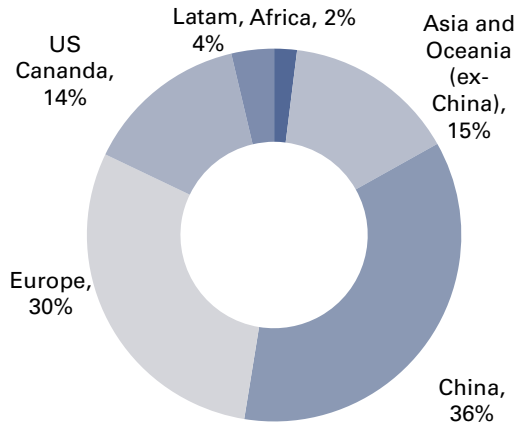
Source: Electricity Markets & Policy Group webpage

Asia to see most renewable installations, driven by China

We expect Asia to be the main focus of renewable installations over the next 20 years (c.54% of renewable installations), mainly driven by China (one-third of installations). We expect Europe to receive c. 25% of new renewables installations and the US/Canada 15%.

Exhibit 54: We expect China to account for c.36% of wind installations globally over 20 years

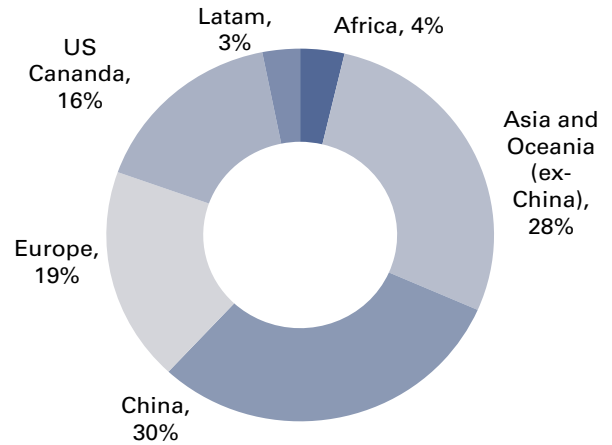
Wind – geographical split in installations (€1.6 tn capex)



Source: IEA and Goldman Sachs Global Investment Research.

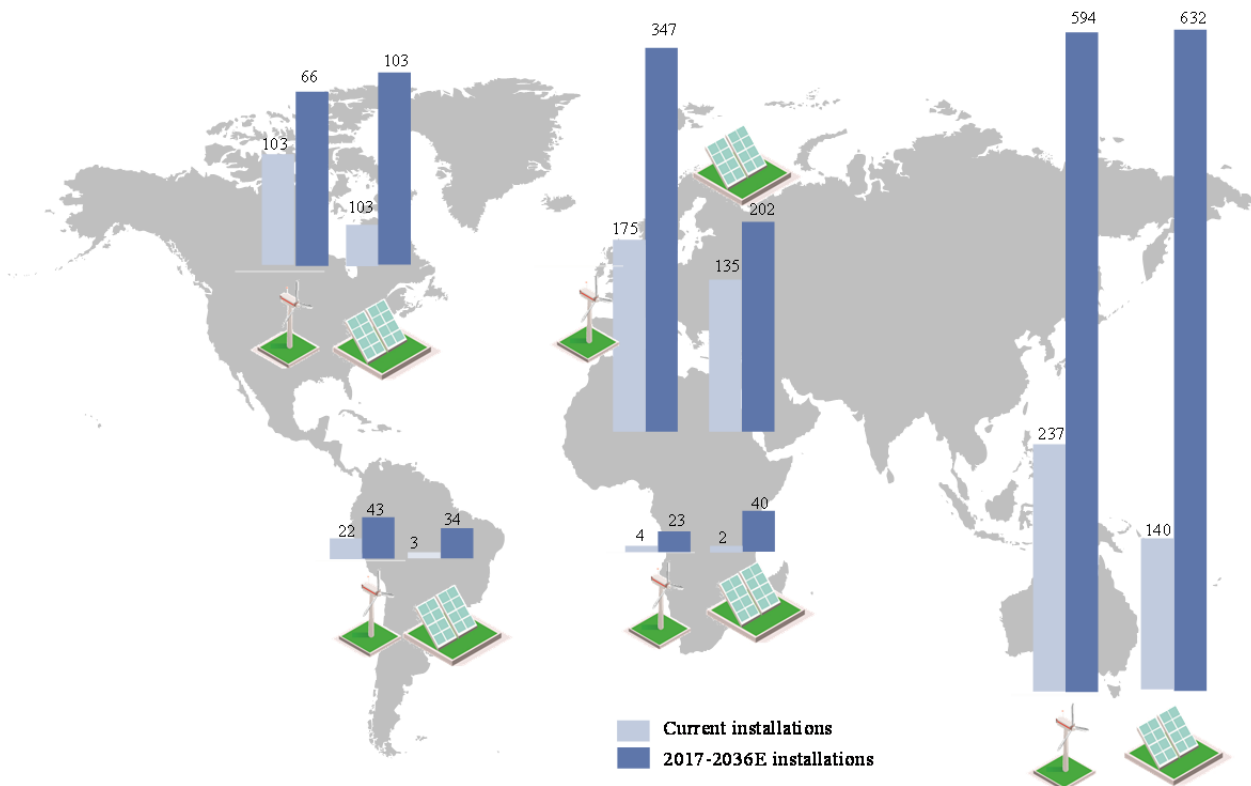
Exhibit 55: We expect Asia and Oceania to account for 58% of the total solar installations over 20 years

Solar - geographical split in installations (€1.1 tn capex)



Source: IEA and Goldman Sachs Global Investment Research.

Exhibit 56: Over 20 years, we see c.630 GW of solar and wind investment in Asia and c.350 GW of wind in Europe 2017-2036 installations (GW)



Source: IEA and Goldman Sachs Global Investment Research.

How to benefit from the renewable super-cycle?

Developers or manufacturers?...we think both

We believe that the manufacturers and the developers are well placed to benefit from the renewables trend. We see Vestas and Acciona as the most attractive European pure-plays exposed to renewables. Looking at renewable pure-plays worldwide, we would highlight Singyes Solar (Asian solar developer; covered by Frank He), Sunrun (US solar developer; covered by Brian Lee), Huaneng Renewables and China Longyuan Power (Asian wind developers; covered by Franklin Chow), among others, as interesting names leveraged to this theme.

We estimate that the profit pool for manufacturers and developers over the next 20 years (€1 tn) could be split c.20% for manufacturers and 80% for developers.

Exhibit 57: We estimate a profit pool of c.€200 bn for manufacturers and €825 bn for developers

Profit pool for developers and manufacturers (2017-2036E)

| Manufacturers | Wind | Solar | Total |
|-----------------------|------|-------|------------|
| Capex (€tn) | 1.6 | 1.3 | 2.9 |
| Net income (€bn) | 135 | 65 | 200 |
| Net income/market cap | 171% | 327% | 202% |

| Developers | Wind | Solar | Total |
|-----------------------|------|-------|------------|
| Capex (€tn) | 1.6 | 1.3 | 2.9 |
| Net income (€bn) | 422 | 397 | 819 |
| Net income/market cap | | | 63% |

Source: Goldman Sachs Global Investment Research.

Exhibit 58: We assume an average 7% return (pre-tax) for developers and a 10% EBIT margin for manufacturers/7.3% for solar manufacturers

Assumptions

| Manufacturers | Wind | Solar |
|---------------|-------|-------|
| EBIT margin | 10.0% | 7.3% |
| Cost of debt | 3% | 3% |
| Tax rate | 30% | 30% |

| Developers | Wind | Solar |
|----------------|------|-------|
| Pre-tax return | 7.0% | 7.0% |
| Cost of debt | 3% | 3% |
| Tax rate | 30% | 30% |

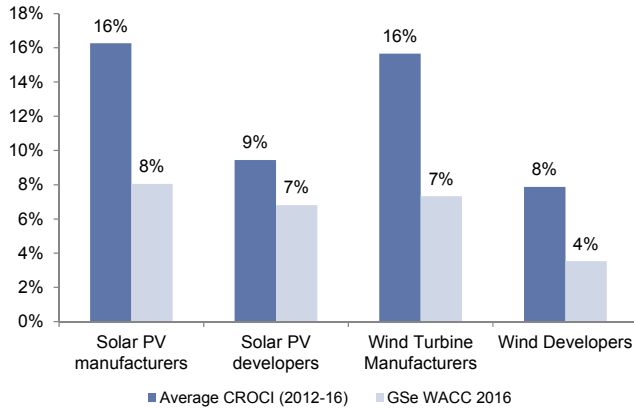
Source: Goldman Sachs Global Investment Research.

Manufacturers provide higher returns but have a higher cost of capital, associated with more volatile earnings

We have looked at the historical returns of the pure players (developers and manufacturers) in our global coverage in the solar and wind industry, and also our forecast returns (in terms of CROCI). We compare these with the cost of capital. We conclude:

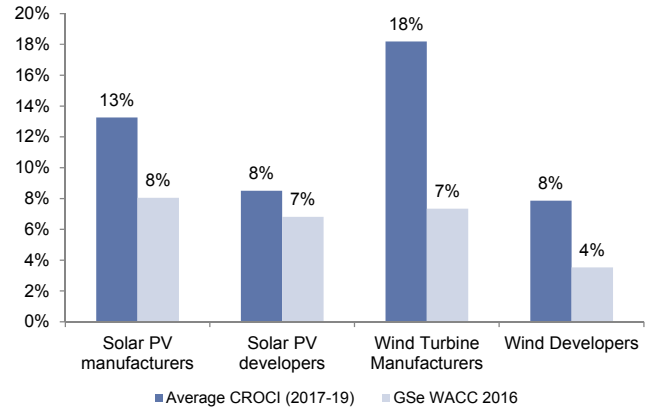
- Manufacturers have higher returns than developers:** Solar and wind manufacturers have enjoyed returns c.16% per year on average over the period 2012-16, vs. 9% on average for developers. Going forward, we expect manufacturers to continue achieving higher returns than developers, with c.16% average returns over the period 2017-19E, vs. 8% for developers.
- Manufacturers have higher risks reflected in a higher cost of capital:** We estimate that the manufacturers have a cost of capital of c.8% on average, vs. c.5% for developers. We believe that the lower cost of capital for developers reflects lower earnings/returns volatility (particularly for wind developers as seen in Exhibits 59 and 60).

Exhibit 59: Historically, manufacturers have had higher returns and a higher cost of capital than developers...
 Historical returns vs. estimated cost of capital – solar/wind developers vs. manufacturers



Source: Company data, Goldman Sachs Global Investment Research.

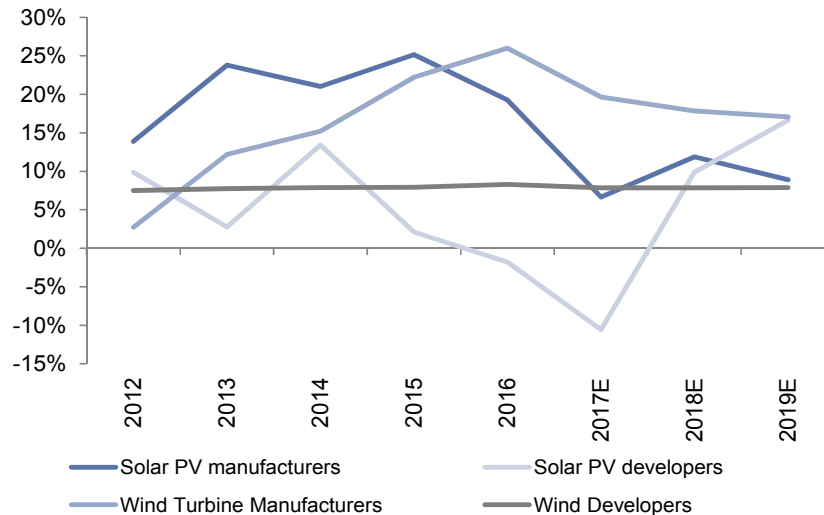
Exhibit 60: ... and we expect the same going forward
 Forecast returns vs. cost of capital – solar/wind developers vs. manufacturers



Source: Goldman Sachs Global Investment Research.

The returns of wind developers have been, and on our forecasts will remain, much more stable than the returns of manufacturers or solar developers (Exhibit 61). We believe that this lower volatility deserves a premium in terms of valuation, reflected in a lower cost of capital.

Exhibit 61: Although the returns of wind developers are expected to be below the returns of manufacturers and solar developers, we highlight the low historical volatility of these companies
 CROCI



Source: Company data, Goldman Sachs Global Investment Research.

Vestas, Acciona, Huaneng Renewables, China Longyuan Power our top picks in wind

- **Wind players:** Among wind manufacturers, **Vestas** (a European player also exposed to the US) remains a top pick. In terms of wind developers, we highlight **Huaneng Renewables Corp and China Longyuan Power** in China, **Acciona** in Europe. We also highlight **Nextera** in the US as being structurally well positioned given its leading market position in the wind development business; we are Not Rated on this stock. Additionally, Prysmian is a European company geared to growth in wind offshore.

Singyes Solar and Sunrun are among our top picks in Solar

- **Solar Players:** Among solar manufacturers we highlight LONGi Green Energy Technology (Asian player). Among developers, we highlight Singyes Solar, Sunrun and 8 point3 Energy Partners.

Exhibit 62: We see Longi Green Energy Technology and Vestas as the most attractive manufacturers; regarding developers, we highlight Huaneng Renewables Corp, China Longyuan Power, Acciona. Additionally, we highlight Prysmian as a company geared to wind offshore growth
Interesting pure plays in the solar/wind industry globally

| Industry | Company | Region | Analyst | Rating | 12 month Price target | Last close | Implied Return | Thesis |
|---|-----------------------------------|-----------|--------------------|--------|-----------------------|------------|----------------|---|
| Solar manufacturers | LONGi Green Energy Technology Co. | Asia | Frank He | Buy | Rmb21.9 | Rmb14.8 | 48% | As a leading mono wafer manufacturer in China, Longi is benefiting from the structural demand growth for high efficiency wafers in the coming years, thanks to supportive government policies, competitive cost and growing penetration on distributed generation projects. Despite the potential slowdown in global solar installations in 2017E-19E (7% annual decline), we expect Longi to achieve 21% shipment CAGR in 2016-19E and its global wafer shipment market share to increase from 10% in 2016 to 21% in 2019E. |
| Solar developers | Singyes Solar | Asia | Frank He | Buy | HK\$ 4.4 | HK\$3.5 | 27% | We favor Singyes given improved earnings visibility following recent updates on its robust order backlog, potential margin expansion, and significantly lower refinancing risk due to the ongoing disposal of its self-operated projects in Xinjiang and Gansu. |
| | Sunrun Inc. | US | Brian Lee, CFA | Buy | \$9.00 | \$5.12 | 76% | We see Sunrun offering above-market growth potential given ongoing market share gains in the US solar residential vertical, which we expect to be a rare source of growth in a depressed cyclical backdrop for the global solar industry in 2017. To that end, as a downstream installer, Sunrun is also poised to benefit from lower costs as solar equipment prices are declining at a rapid pace and shifting more profitability to customers as inventories get cleared in coming quarters. |
| | 8point3 Energy Partners | US | Brian Lee, CFA | Buy | \$15 | \$13 | 12% | CAFD remains one of the Buy ideas in our US solar coverage owing to an attractive combination of yield plus growth with limited exposure to a deteriorating cyclical environment given its high-quality asset based, contracted power business model. |
| Wind manufacturers | Vestas Wind Systems A/S | Europe/US | Manuel Losa | Buy | Dkr 730 | DKr 574 | 27% | On our estimates Vestas looks cheap on absolute and relative terms (trading at significant discount to peers, capital goods average and utilities on EV/EBITDA). We expect Vestas to start distributing a dividend driven by a strong FCF generation and a solid balance sheet position. The extension of the wind tax credit in the US will drive additional volume for the industry. |
| Wind developers | Huaneng Renewables Corp. | China | Franklin Chow, CFA | Buy | HK\$ 3.2 | HK\$2.6 | 24% | Slowing wind farm capacity growth and constructive government policy offers robust operating leverage for Huaneng Renewables. Further, absence in certain regions with high power grid offtake curtailment (e.g. Gansu, Heilongjiang, Ningxia) positions the company for more resilient utilization. |
| | China Longyuan Power | China | Franklin Chow, CFA | Buy | HK\$ 7.3 | HK\$6.0 | 21% | Our Buy investment case focuses on capex discipline and constructive government policy. In 2017, we expect rising utilization to offer operating leverage for its wind farms, while in 2018 we see falling gearing and capex producing a positive free cash flow after dividend. |
| | Acciona SA | Europe | Manuel Losa | Buy | € 89 | €84 | 6% | We see Acciona as the best positioned Spanish utility to take advantage of a potential increase in support of renewables as Spanish renewables explains c.29% of our EV valuation in the SOTP. Additionally a potential increase in government expenditure could benefit the non-energy business of Acciona such as civil construction. |
| Other companies (non-pure player company) | Prysmian | Europe | Daniela Costa | Buy | €30 | €26 | 17% | We expect Prysmian to outperform from 2H17 on three structural drivers: 1) Construction Product Regulation (July onwards) to allow large market share wins and doubling of margin in Trades & Installers by 2021. 2) Starting late 2017, Germany's transmission grid expansion and further wind offshore tenders can drive Energy Projects' backlog above prior peak by 2019. 3) The recent Verizon order supports our view that global fibre penetration can double by 2020 helping drive volumes and positive pricing for Telecoms. |

Source: Goldman Sachs Global Investment Research, Datastream.

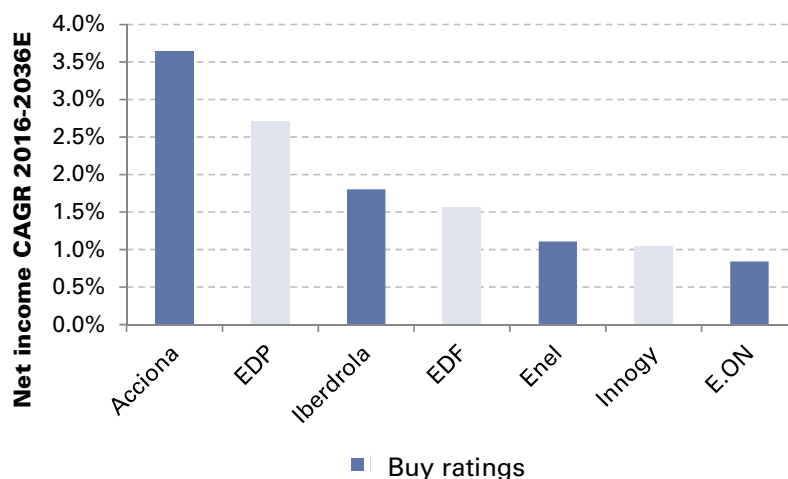
What does it mean for European companies?

We see European companies as well positioned to benefit from expected wind/solar growth. We favour Acciona, Iberdrola and Enel among developers and Vestas among manufacturers.

Buy Acciona, Iberdrola and Enel among wind developers

We see Acciona, Iberdrola and Enel as the most attractive European utilities in our coverage through which to gain exposure to renewables growth. We estimate renewables installations will drive a c.4% net income CAGR (2016-2036E) for Acciona, a c.2% CAGR for Iberdrola (the largest wind developer with > 26% of the wind capacity of all European utilities) and a c.1% net income CAGR for Enel.

Exhibit 63: We expect wind/solar investments to drive a 4% net income CAGR (2016-36E) for Acciona, 3% EDP, c.2% for Iberdrola and EDF, and 1% for Enel
Net income CAGR, 2016-36E, from renewables



Last close prices for Buy-rated stocks as of June 2: Acciona €83.9; Enel €4.73, E.ON €7.83

Source: Goldman Sachs Global Investment Research.

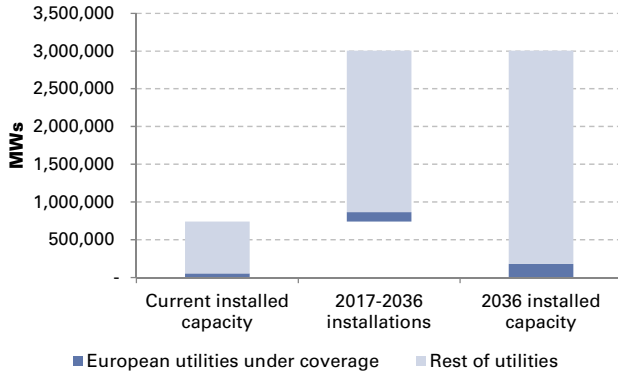
Although we expect European utilities to lose market share in renewables

We expect European utilities to lose market share in wind/solar installations over the next 20 years, from c.8% currently to c.6% by 2036E as:

- We expect a significant proportion of installations to be in Asia (China particularly), where European utilities have low market share; and,
- We expect almost as high a volume of wind installations as solar installations: most of these installations are not owned by utilities.

Exhibit 64: Our forecasts assume European utilities lose market share in wind/solar capacity, from 8% currently to 6% by 2036, as a significant proportion of installations...

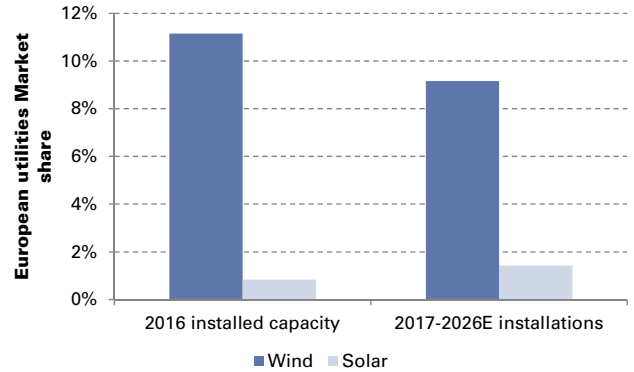
Wind and solar installed capacity – European utilities vs. ROW



Source: IEA, Company data, Goldman Sachs Global Investment Research.

Exhibit 65: ...should be in Asia and/or in solar PV where European utilities have low market share (c.1% in solar vs. 11% in wind globally)

Global market share for European utilities in solar and wind



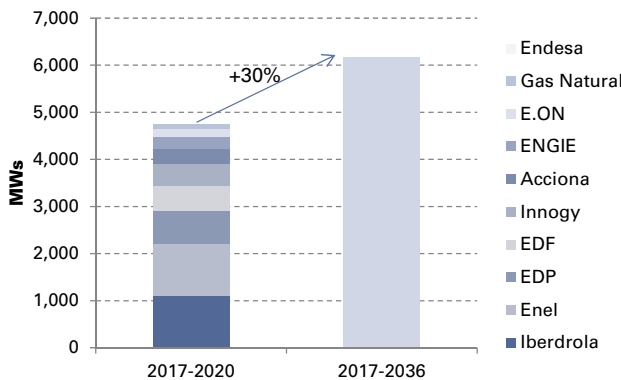
Source: Company data, Goldman Sachs Global Investment Research.

...we see an acceleration in renewables growth post 2020

We expect renewables growth to accelerate post 2020, as wind/solar become competitive. We estimate that annual installations over the period 2017-36 will be 30% higher than over the period 2017-20E. We expect this to accelerate net income growth (vs. 2017E net income) to an average 2.5% pa in 2017-36 (vs. 1.5% for 2017-20E) for Acciona, EDP, Iberdrola, Innogy, EDF and Enel.

Exhibit 66: We expect developers to raise their renewable installations by 30% on average vs. the current run-rate...

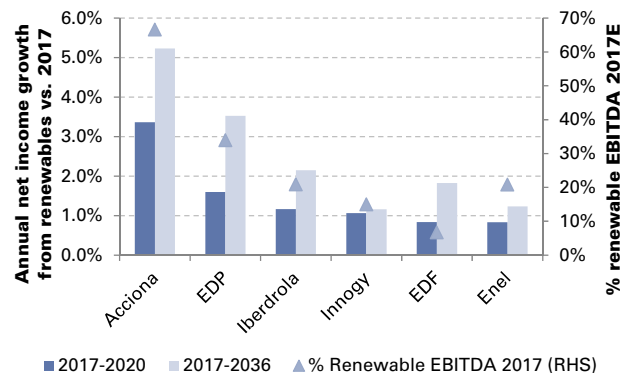
Annual renewable capex for main European developers



Source: Goldman Sachs Global Investment Research.

Exhibit 67: ...accelerating net income from renewables to a 2.5% CAGR on average (vs. 1.5% currently)

Net income growth from renewables



Source: Goldman Sachs Global Investment Research.

Wind/solar to require c.€170 bn of investment by European utilities over the next 20 years (c.40% of their market cap) and imply €5 bn of extra earnings (c.20% of sector net income or a 1% EPS CAGR through 2017-36E)

Assuming a cost of c.€1.4 mn/MW for wind (including offshore) and €1.1 mn/MW for solar, we estimate c.€170 bn of investment in renewables by the European utilities over the next 20 years (c.40% of the sector's current market cap).

We estimate that this could generate c.€5 bn of extra earnings for the utilities over the next 20 years. This would imply c.20% growth in terms of net income for the sector, or 1.1% EPS CAGR 2017-36E.

Exhibit 68: We expect renewable installations to require c.€169 bn of investment in wind and solar by the European utilities

Capex implications

| | Wind | Solar | Total |
|---------------------|-------|-------|------------|
| Installations (GWs) | 108 | 16 | 123 |
| Multiple (€mn/MW) | 1.40 | 1.15 | |
| Capex (€bn) | 150.7 | 17.8 | 169 |

Source: Goldman Sachs Global Investment Research.

Exhibit 69: We estimate that the required investment could derive c.€5 bn of incremental net income (c.23% of the sector’s market cap) for the sector or a 1.1% CAGR 2017E-2036E

Net income impact

| Net income contribution | |
|--------------------------|------------|
| Total Capex (€bn) | 169 |
| Expected return | 7% |
| Cost of debt | 3% |
| Tax rate | 30% |
| Net income (€bn) | 5 |

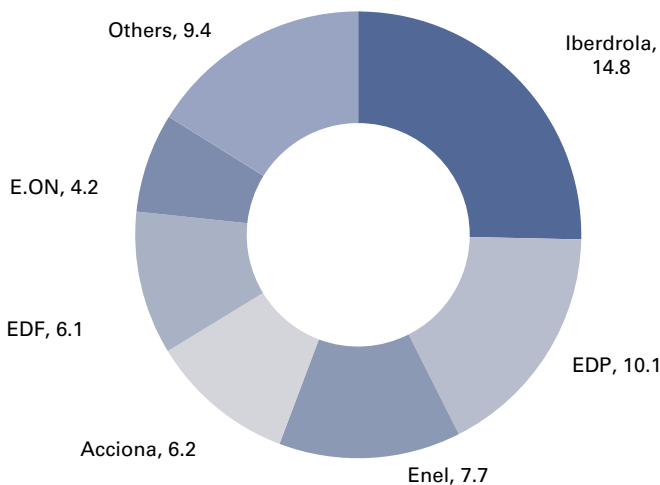
Source: Goldman Sachs Global Investment Research.

Beyond the pure plays (Acciona), we see EDP, Iberdrola, EDF, Enel and EON as the most geared companies to renewable growth (among utilities)

Iberdrola, EDP, Acciona, EDF and Enel are the largest European wind developers in our coverage accounting for more than 50% of the renewable installations owned by European utilities. We believe that scale provides competitive advantage, and we see these companies as well positioned to benefit from renewables growth.

Exhibit 70: Iberdrola, EDP, Acciona, EDF and Enel stand out as the European utilities more levered to wind and solar

Current wind and solar installed capacity (GW)



Source: Company data, Goldman Sachs Global Investment Research.

We see the large players continuing to pull away, driven by economies of scale

We see scale as a key competitive advantage for developers going forward: it should allow them to reduce the costs of electricity production. However, we do not expect developers to benefit from the cost reduction, as we believe it will mainly be passed through to consumers. Therefore, we do not expect scale to directly positively impact companies' earnings. However, we believe it should allow the larger companies to outgrow the small players in terms of projects, given their price advantage.

We see the following costs as likely to benefit from economies of scale: investment cost per MW, O&M (Operation and Maintenance) and financing costs. We estimate that in combination these could help lower the LCOE by 20%.

- **Capex:** We expect large orders to benefit from lower investment costs for developers (Vestas reported this when it received its large order from Norway). We estimate a saving of c.10%.
- **O&M:** We estimate that the operating leverage of wind manufacturers to O&M is c.40% (every 10% increase in volumes implies a c.6.3% increase in costs). As O&M explains c.30% of the costs for wind turbines, we estimate c.12% operating leverage for wind developers (every 10% increase in installed capacity would imply a c.8.8% increase in costs). We highlight that operating leverage could be even higher, as we also see economies of scale on a part of the remaining costs which are unrelated to O&M.
- **Financing:** We would expect large corporates to be able to finance at cheaper rates. Additionally, we believe that they can raise debt at the corporate level (vs. project finance for smaller developers), which could help reduce the cost of capital.

Exhibit 71: We would expect large corporates to be able to be more aggressive on pricing in wind auctions, thanks to lower investment and O&M costs and a lower cost of debt

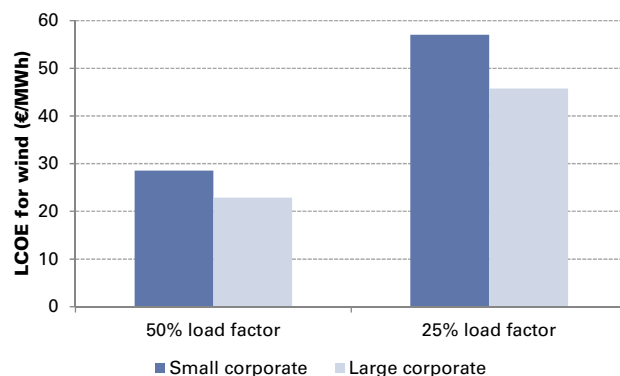
LCOE sensitivity to changes in investment cost, operating costs and a lower cost of debt

| LCOE sensitivity | %change |
|--|---------|
| 10% reduction in Investment cost | -6% |
| 10% reduction in operating costs (including O&M) | -4% |
| 10% reduction in the cost of debt | -2% |

Source: Goldman Sachs Global Investment Research.

Exhibit 72: We estimate a c.20% lower LCOE for a large corporate vs. a small one

LCOE for wind (€/MWh) – large corporate vs. small corporate (large corporate assumes 12% lower O&M, 50% lower cost of debt and 10% lower investment)



Source: Goldman Sachs Global Investment Research.

Among our coverage, we see Acciona, Iberdrola and Enel (EON) as the most compelling opportunities among the developers to benefit from renewable growth

Acciona (Buy): We highlight Acciona (Buy): it trades at a discount to the sector despite higher earnings growth. We estimate a 16% EPS CAGR through 2020, driven by renewable installations and business geared to Spanish GDP (construction and real estate). In terms of valuation, with a 2018E P/E of 16.3x, Acciona trades in line with the sector and at a 56% discount to peer EDPR, while offering a sector-leading average 2018E dividend yield of 5% on our estimates.

Enel (Buy; on the Conviction List): We remain Buy-rated on Enel: it has high-single digit earnings growth, supported by continued infrastructure capex on renewables and grids. On our forecasts, Enel trades at a c.30% discount to the sector on 2018E P/E, while offering a 2018E 6.3% dividend yield. Further, assuming a re-leveraging to 3.25-3.50x, at the low end of the peer group range, Enel could gear up its balance sheet by more than €10 bn, which could allow a large buyback programme, or accelerate growth via acquisitions.

Iberdrola (Buy): We remain Buy-rated on Iberdrola: we see stronger earnings growth than at peers, consistent with its higher earnings targets (6% EBITDA CAGR through 2017-20), driven by accelerated capex in low-risk, quality infrastructure activities. With a 2018E P/E of 14.7x, we view Iberdrola’s valuation as attractive in the context of infrastructure assets. Further, we expect its dividends to grow at 5% CAGR, yielding 5.3% by 2020E.

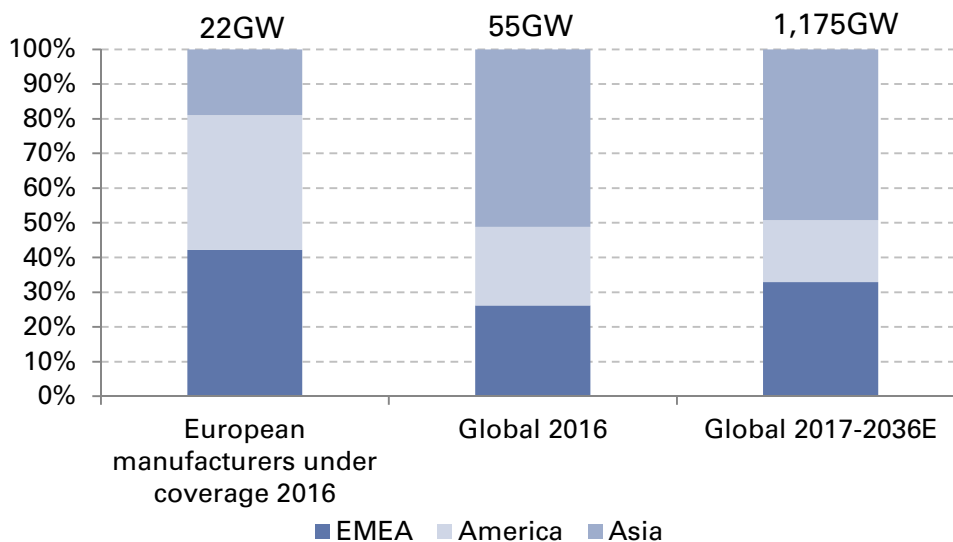
Buy Vestas among the European wind turbine manufacturers

We see Vestas as the most attractive European wind turbine manufacturers in our coverage through which to gain exposure to renewables growth, driven by its larger scale (a key advantage in our view) and strong cash-flow generation. We estimate wind installations will drive a 15% EPS CAGR for Vestas (2017-20E) and a c.7.5% FCF yield on average over the period. For more details please see our note *Europe: Clean Energy: Wind: Wind manufacturers to benefit from change in the generation mix*, published June 5, 2017.

We expect the European wind turbine manufacturers in our coverage to gain market share globally (from 40% to 43%), supported by their larger scale

We see the European wind turbine manufacturers as well positioned to benefit from growth in wind installations, helped by their larger scale (we estimate that the three wind turbine manufacturers in our coverage reached c.40% market share in 2016 and we expect this to grow to 43% on average over the period 2017-2036E).

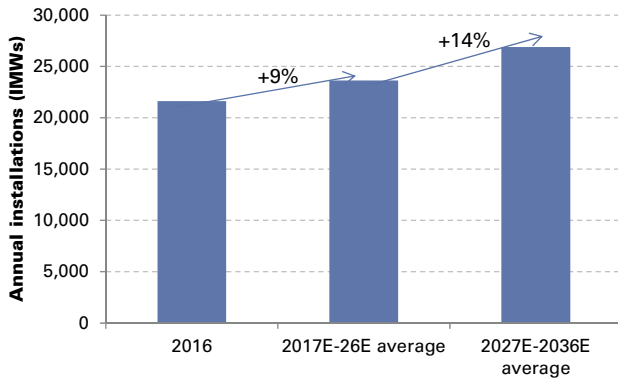
Exhibit 73: European manufacturers are well positioned to capture market share
Geographical split – European manufacturers vs. global wind installations



Source: Company data, Goldman Sachs Global Investment Research.

In terms of the potential profit pool, we estimate a revenue opportunity of c.€790 bn over the next 20 years, and c.€58 bn in terms of accumulated net income (2.5 times the combined market cap). This assumes a 10% EBIT margin in manufacturing and a 30% tax rate.

Exhibit 74: We expect average 2017-2036E annual installations by European manufacturers in our coverage to be c.17% above the 2016 level
European wind turbine manufacturers under coverage – 2016 installations vs. 2017-36E average



Source: Company data, Goldman Sachs Global Investment Research.

Exhibit 75: We estimate that the profit pool would be c.€58 bn for the European wind turbine manufacturers in our coverage (c.2.5x their market cap) over the next 20 years
Profit pool for wind turbine manufacturers in our coverage

| | Manufacturing | O&M | Total | Comments |
|-----------------------|---------------|-----|----------------|---------------------------|
| MWs | 505,030 | | 505,030 | 43% of total installation |
| Revenues (€bn) | 707 | 80 | 787 | |
| Net income pool (€bn) | 49 | 8 | 58 | 2.5x the market cap |

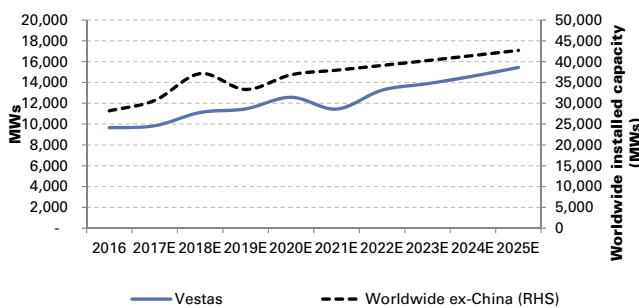
Source: Goldman Sachs Global Investment Research.

Scale is the key competitive advantage – large players to keep pulling away

Among the European wind turbine manufacturers, we see Vestas as the best positioned company in our coverage, consistent with three key competitive advantages:

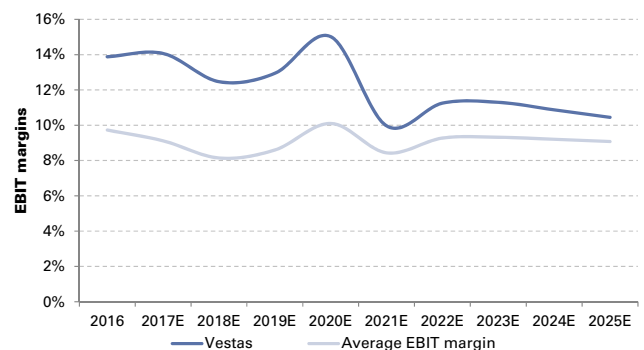
- **Scale:** We expect economies of scale (such as cheaper supply chain) and stronger cash flow generation to allow the company to invest intensively in R&D. We believe that higher R&D than peers, and its global track record, will allow Vestas to continue gaining market share (Exhibit 76).
- **Operating leverage:** We see Vestas as the wind turbine manufacturer in our coverage with the lowest level of outsourcing. We see this as positive, at a point when spare capacity is very tight. We believe this is one reason for Vestas’s above-peer margins (Exhibit 77).
- **Simplicity:** Vestas is not currently involved in substantial M&A integration. We see this too as a positive, as the focus of the company should remain on reducing its LCOE below that of peers, helping it gain market share.

Exhibit 76: We expect Vestas to continue growing its top line, driven by market growth
MWs installed - Vestas vs. worldwide installations



Source: Company data, Goldman Sachs Global Investment Research.

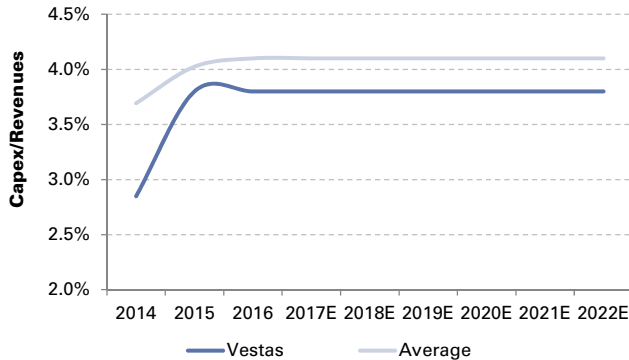
Exhibit 77: We believe that its larger scale will allow Vestas to maintain its margins above those of peers
Vestas Margins in manufacturing capacity vs. average margins for wind manufacturers



Source: Company data, Goldman Sachs Global Investment Research.

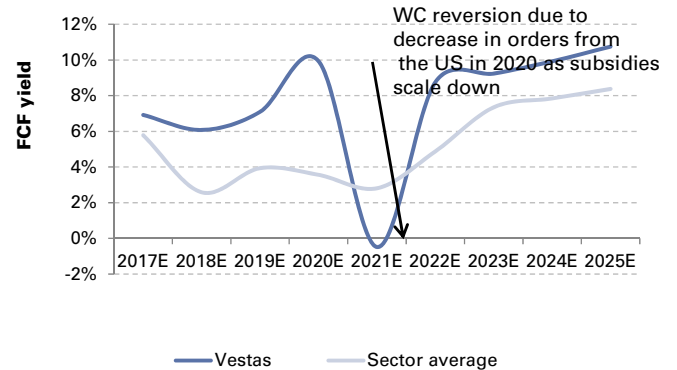
We expect Vestas to be able to maintain its capex/revenues ratio below 4% (vs. a 4.4% average for its European peers), driven by its larger scale. We expect this to allow Vestas to outperform its peers in terms of FCF generation.

Exhibit 78: We expect its large scale to allow Vestas to hold its capex/revenues ratio below that of peers...
 Vestas Capex/revenues vs. average for wind turbine manufacturers



Source: Company data, Goldman Sachs Global Investment Research.

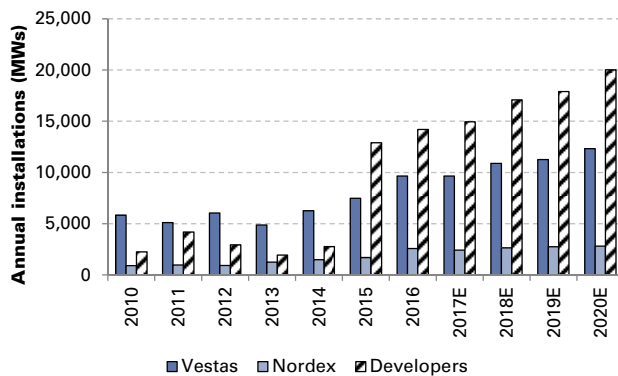
Exhibit 79: ...implying stronger cash flow generation
 Vestas FCF yield vs. average for wind turbine manufacturers



Source: Company data, Goldman Sachs Global Investment Research.

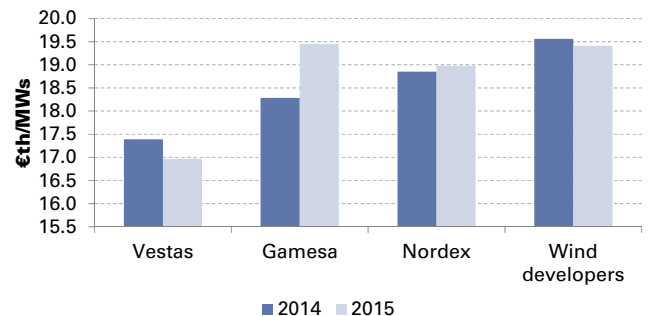
We also see the O&M business as an important growth driver for the wind manufacturers, and especially for Vestas. As in the manufacturing business, we see scale as a key competitive advantage as: (1) we expect Vestas's annual installations to represent c.60% of the aggregated annual installations of five of the largest wind developers (Iberdrola, EDPR, Acciona, Nextera and Enel); and (2) we see economies of scale as the key to Vestas's competitiveness in terms of costs in O&M (Exhibits 80 and 81).

Exhibit 80: Annually, Vestas should install c. 60% of the combined total of Iberdrola, EDPR, Acciona and Enel
 Renewables annual installations – Vestas and Nordex vs. the aggregated total of five large developers



(* Developers is the aggregated amount from Iberdrola, EDPR, Acciona, Enel and Nextera)
 Source: Company data, Goldman Sachs Global Investment Research.

Exhibit 81: Higher MWs under O&M allow Vestas to achieve costs below those of peers and developers
 O&M costs – Manufacturers vs. Wind developers (average EDPR and Iberdrola)



Source: Goldman Sachs Global Investment Research.

European companies can afford renewables growth

We estimate that the European companies we cover (both manufacturers and developers) could afford the capex implied by our forecasts for wind/solar installations.

Profits from wind/solar assets should raise the leverage capacity of developers

We estimate that over the next 20 years, the main European developers will invest c.€205 bn, of which c.€170 bn will be in new assets and €35 bn in repowering. This would represent c.€10 bn of annual investments on wind/solar over the period, in turn implying a step-up of c.32% vs. current renewable capex of c.€8 bn (Exhibit 82).

We estimate that the step-up in capex vs. current run-rate could be financed through the profits from new assets. Assuming a 7% return, we estimate that the €168 bn of capex invested in new assets would generate €17 bn of incremental EBITDA, providing leverage capacity of €87 bn (assuming 5x ND/EBITDA) or €4.3 bn of extra annual capex potential (vs. €2.5 bn required).

Strong cash flow should cover the capex requirements of manufacturers

For the manufacturers, we estimate total required capex of c.€29 bn (c.4% of total revenues), representing c.€1.5 bn of annual capex. We expect this to be fully financed by the strong cash flow generation of these companies. We believe that capex will represent less than 55% of the cash from operations (after taxes) of these companies (Exhibit 83).

Exhibit 82: Profits from new wind/solar assets should increase leverage capacity beyond required levels to finance our forecast installations

Developers – capex requirements

| €mn | 2017-2036 | Annual Capex |
|---|----------------|---------------|
| Capex required | 203,104 | 10,155 |
| Capex new installations | 168,538 | 8,427 |
| Capex repowering | 34,565 | 1,728 |
| Current run-rate on renewables capex | | 7,698 |
| % total required capex | | 76% |
| Potential re-leverage | 87,078 | 4,354 |
| % total required capex | | 43% |
| Potential leverage on renewables | 5.00x | |
| EBITDA from new installations | 17,416 | |
| Return | 7% | |
| Capex | 168,538 | |
| D&A (30 years) | 5,618 | |
| Capex required | | 10,155 |
| Current renewable | | 12,052 |
| Capex+Potential re-leverage | | |

Source: Goldman Sachs Global Investment Research.

Exhibit 83: Strong cash flow should cover the capex requirements of manufacturers

Manufacturers – capex requirements

| Wind manufacturers (€mn) | 2017/2036 | Annual |
|-------------------------------------|---------------|--------------|
| Required Capex | 29,181 | 1,459 |
| Total revenues | 722,041 | 36,102 |
| Capex/Revenues ratio | 4.0% | 4.0% |
| Cash from operations (ex-WC) | 53,103 | 2,655 |
| Total revenues | 722,041 | 36,102 |
| EBIT margin | 11% | 11% |
| Tax rate | 30% | 30% |
| Capex/Cash from operations | 55% | 55% |

Source: Goldman Sachs Global Investment Research.

M&A to retain a role in the wind industry

We expect M&A to remain important for the manufacturers and developers. Developers are currently using disposals to crystallize value and finance growth. In the case of manufacturers, we expect further consolidation in the industry. We also see upside risk from capital goods companies potentially bidding for wind manufacturers to capture their growth potential.

We expect further disposals of wind farms to crystallize value

Wind developers have been disposing of wind assets at implicit valuations well above their trading multiples (we estimate than on average recent transactions have been undertaken at c.30% premiums to the EV/EBITDA trading multiples of the pure wind developers. In our view, the premium has been mainly driven by a lower cost of capital and the direct access to the cash flows provided.

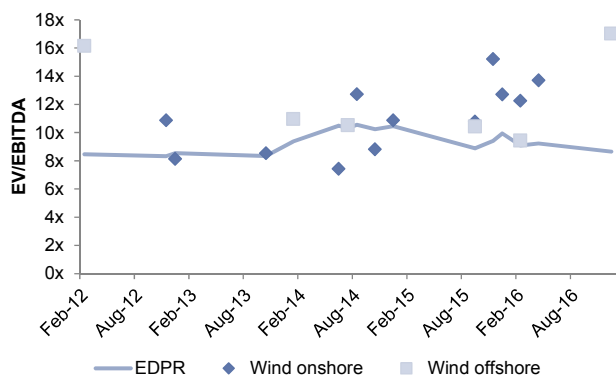
- **Lower cost of capital:** Around two-thirds of the buyers of wind assets have been financial investors (e.g. infrastructure and pension funds) which have a lower cost of capital than the wind developers.
- **Access to cash flows:** We believe that part of the implied premium can be justified by the direct access to the cash flow generated by the assets. Wind buyers have direct access to the strong cash flow generation of these assets, unlike the shareholders of wind developers, which depend on a dividend which could be linked to net income, rather than cash flow.

We expect further consolidation in the wind industry to drive more M&A

We see two key drivers of M&A among wind turbine manufacturers:

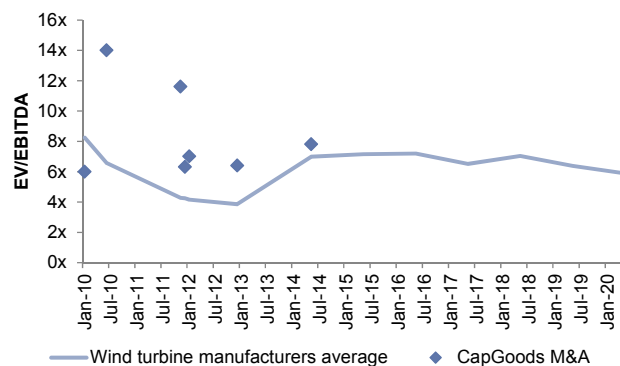
- **Previous consolidation:** Over the last two years, we have seen two large M&A transactions involving the European wind turbine manufacturers (Nordex-AWP and Gamesa-Siemens). We would expect additional transactions, as we see scale as the key competitive advantage for wind manufacturers.
- **Growth at a low valuation:** Our analysts expect limited growth in the capital goods sector. We believe that wind manufacturers offer access to a growth market with attractive returns at a relatively low valuation (e.g. Vestas trades at 6.7x EV/EBITDA 2017 and offers 9% EBITDA CAGR 2017-20E which compares with the capital goods average 2017 EV/EBITDA at 12.5x and EBITDA CAGR 2017-20E at 5%).

Exhibit 84: Renewable disposals have generally crystallized value above implicit valuations in the market
Renewable disposals - valuation



Source: Company data, Goldman Sachs Global Investment Research.

Exhibit 85: ...and so have Capital goods M&A transactions
Capital goods – M&A transactions



Source: Goldman Sachs Global Investment Research.

Risks: Competition to put pressure on returns, other technologies

We see potential pressure on returns as the main risk associated with developers and manufacturers going forward.

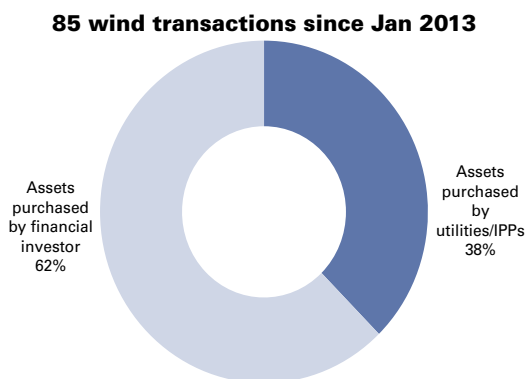
New entrants could add to pressure on the returns for developers

We see new entrants as the main risk, and one that could add downside pressure to renewable returns going forwards. We see two main reasons why new entrants could prompt lower returns:

- Pushing for market share:** We have seen non-utilities players (oil/construction/food companies) enter the renewables business over recent years. We would expect these players to bid aggressively in auctions to penetrate the market. We do not see these players as a threat in the long term as: (1) a strategy of investing below the cost of capital cannot persist economically in the long term; and (2) we see size as a competitive advantage for utilities vs. these new players.
- New investor types could afford lower returns:** As highlighted on the previous page, infrastructure/pension funds have been willing to acquire renewable assets at valuations well above implicit levels. We believe that this is driven, partially, by a low cost of capital requirement. Utilities have been benefiting from this trend, as disposals have been a way to crystalize value and finance new projects. However, we see a risk to utilities' returns if infrastructure/pension funds start to invest in green field projects, instead of their traditional brown field projects.

Exhibit 86: Over the last 4.5 years, around two-thirds of wind transactions have seen financial investors such as pension/infrastructure funds acquiring

% of transactions undertaken by financial investors



Source: Company data.

Exhibit 87: Infrastructure funds benefit from a low cost of capital, which is an important driver helping to bid successfully in new auctions

LCOE sensitivity to different factors

| Sensitivity analysis for LCOE | |
|-------------------------------------|------|
| 10% reduction in turbine price | -5% |
| 10% reduction in construction price | -2% |
| 10% increase in load factor | -9% |
| 10% decrease in Opex | -4% |
| 100 bps reduction in WACC | -10% |
| 5 years increase in useful life | -6% |

Source: Company data, Goldman Sachs Global Investment Research.

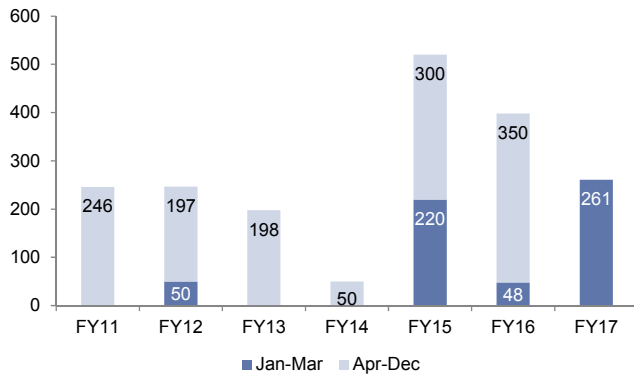
Competitors could add to pressure on margins of wind manufacturers

We see new competitors as the main risk to the wind turbine manufacturers in our coverage. In terms of new competitors, we highlight existing manufacturers from other regions (Chinese players), as well as new players.

However, and for the time being, we do not see the Chinese turbine manufacturers as a significant threat to the European manufacturers. We believe that the increasing volume of orders received by European manufacturers in China over the last three years demonstrates the competitiveness of their products.

Exhibit 88: Vestas and Gamesa have received growing awards...

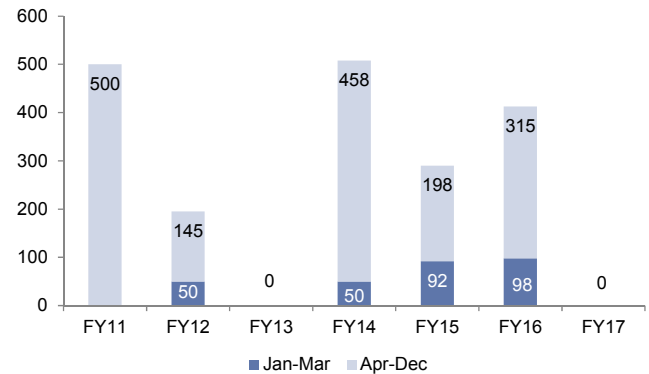
Vestas – announced orders in China



Source: Company data.

Exhibit 89: ... in China over the last three years

Gamesa – announced orders in China



Source: Company data.

Lower wind volumes/margins as cycle reverses is a key risk for manufacturers

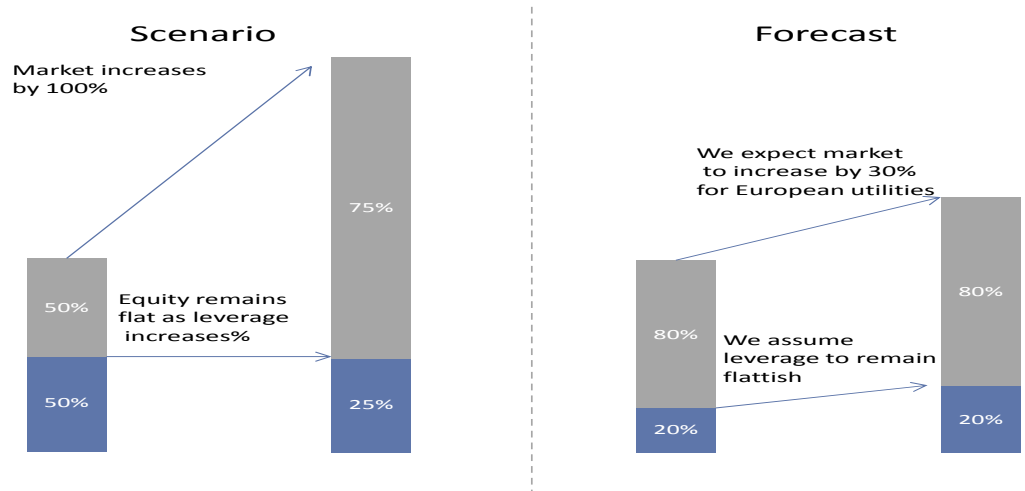
We would define the wind manufacturing business as a cyclical business (see Appendix). The cycle has been historically correlated to economic activity in North America, Europe and China as: (1) these regions are home to most installations; and (2) wind required a subsidy to be profitable and this subsidy was easier to obtain in periods of economic growth. We believe that we are seeing a structural change within the industry, as the costs of wind are set to fall below the costs of other technologies, which we expect to continue driving installations over the next 20 years.

Increase in leverage could reduce growth in profits for the companies

We see a risk to our profit growth forecasts if companies decide to increase their leverage to finance renewable projects, encouraged by easy access to low-cost debt. As per Exhibit 90, we could envisage a scenario in which equity growth remains flat, despite growth projects fully meeting our expectations, were financial leverage to increase from 50% to 75%. In our forecasts, we assume that leverage remains at the same level (c.80%) as most of the companies we cover use corporate loans to finance renewable projects and have not increased their targets in terms gearing ratios at the corporate level.

Exhibit 90: Profit growth could be lower if companies decide to lever up projects

Equity/debt growth depending on scenario



Source: Goldman Sachs Global Investment Research.

Appendix: Lower costs to transform the business cycle

Wind installations have traditionally been driven by environmental policies (mainly in Europe and the US) and then economics (mainly in emerging markets). The significant weighting to Europe/the US in wind installations has historically made this business a cyclical one, depending on environmental policies.

However, as the cost of wind technology continues to decrease, we expect economics to take a more important role in Europe and the US. **We see this driving a structural change in the industry, transforming what was historically a cyclical business.**

Three main players in the cycle: manufacturers, developers and the government

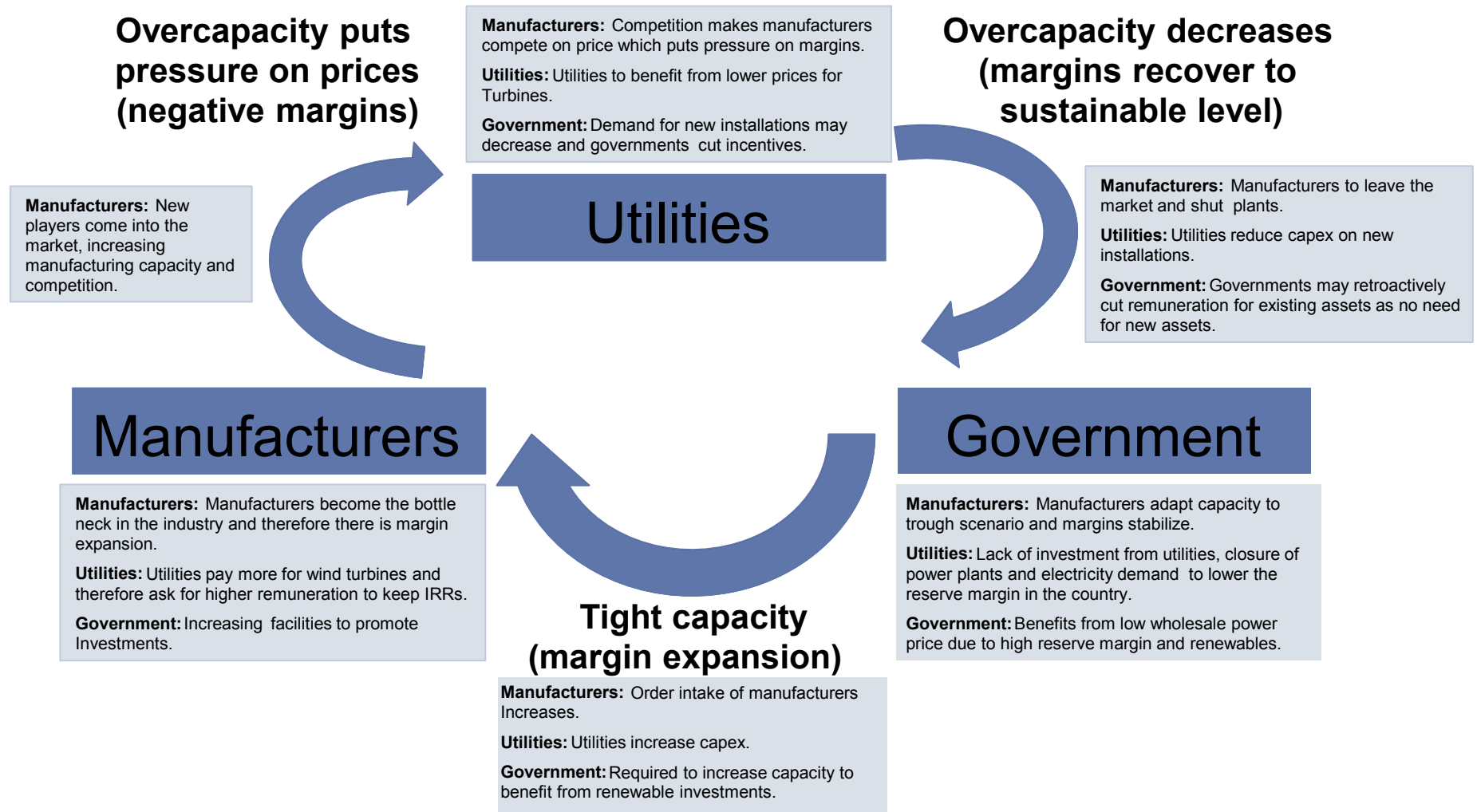
The wind business has historically been a cyclical one with three key groups of participants: manufacturers, utilities and governments.

Depending on the point in time, and the need for wind investments, we would expect certain of these groups to be better placed than others to benefit:

- **Manufacturers** - Winners when there is need to accelerate renewable installations. Growth could be driven by environmental issues, by economics, or by tightness in reserve margins. In this scenario, we would expect governments to attract investment to fulfill their targets, in terms of adding capacity. At this point, we would expect utilities to raise capex and manufacturers to benefit from margin expansion (owing to economies of scale and pricing power) and working capital improvement (driven by an increase in pre-payments).
- **Developers** - Winners when there is need for renewable installations, but there is over capacity in the manufacturing business. This overcapacity could be triggered by a slowdown in installations, or by a very optimistic view of the market on the part of wind manufacturers which have increased their capacity or fixed costs beyond the required level. Overcapacity in the wind manufacturing sector would likely put pressure on turbine prices (competition for volumes), margins (owing to lower economies of scale) and working capital (beyond the reduction in pre-payments, manufacturers could even decide to finance projects for their clients to maintain volumes and offset fixed costs). Lower turbine prices would be a positive for utilities (assuming the same revenues per MWh, as lower investment cost would imply higher returns), but negative for manufacturers (as they would squeeze margins).
- **Governments** – Winners when there is no need for installations, perhaps driven by a fall in electricity demand and low power prices. In this scenario, we have seen governments retroactively cutting incentives to existing power plants (we have seen government intervention in Spain, the Czech Republic, Romania, Greece, Italy and Bulgaria), with limited risk to power prices as overcapacity would likely persist. As the cost of wind power decreases, we believe that the regulatory risk decreases, given a lack of subsidies.

Exhibit 91: We expect governments to continue promoting renewable investments, driven by competitiveness and environmental measures; we believe that manufacturers/developers are therefore well positioned to benefit from a capex super-cycle

Wind turbines business cycle



Source: Goldman Sachs Global Investment Research.

Exhibit 92: 12-month price targets, methodology and risks

| Stock | Currency | Rating | Price Target | Price Target methodology | Risks to Price Target |
|-----------|----------|--------|--------------|--|---|
| Enel | € | Buy* | 5.50 | 20% SOTP, 20% DDM, 60% P/E relative value | lower commodity/power prices, higher country risks premia, weaker FX vs. EUR. |
| Iberdrola | € | Buy | 7.45 | 25% SOTP, 25% DDM, 50% P/E relative value | more than expected intervention; FX (GBP, US, BRL), Spanish macro deterioration. |
| Acciona | € | Buy | 89.0 | 50% SOTP, 50% EV/EBITDA value | lower power prices, lower amount of disposals undertaken at discount to our valuation, worse regulation and higher GDP growth in Spain. |
| Vestas | DKr | Buy | 730.0 | 30% M&A valuation based on 10x EV/EBITDA (average historical transaction utilities sector), 35% DCF, 35% EV/EBITDA value | lower volumes and lower margins, lower M&A potential. |

*Denotes Conviction List membership

Source: FactSet, Goldman Sachs Global Investment Research

Disclosure Appendix

Reg AC

We, Manuel Losa, Alberto Gandolfi and Pragna Kataria, 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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Growth is a composite of next year's estimate over current year's estimate, e.g. EPS, EBITDA, Revenue. **Return** is a year one prospective aggregate of various return on capital measures, e.g. CROCI, ROACE, and ROE. **Multiple** Multiple is a composite of one-year forward valuation ratios, e.g. P/E, dividend yield, EV/FCF, EV/EBITDA, EV/DACF, Price/Book. **Integrated IP score** is a composite of Growth, Return and Multiple scores.

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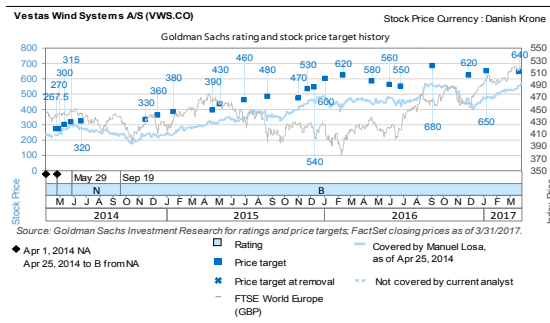
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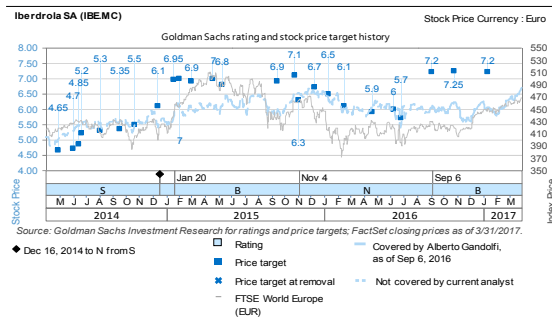
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|--------|---------------------|------|------|----------------------------------|------|------|
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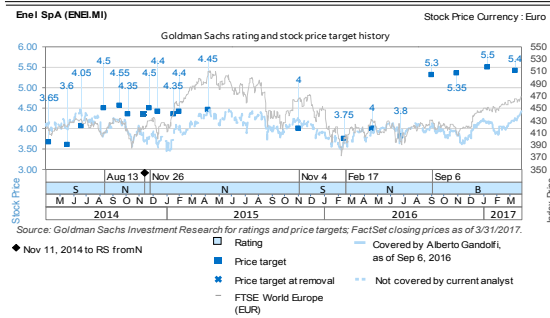
Price target and rating history chart(s)



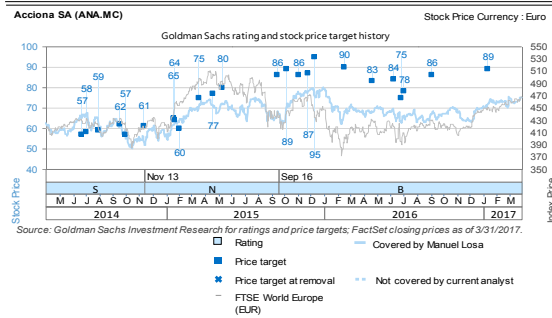
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