Bridging low-carbon technologies

Which Capital Goods companies are driving the low-carbon transition?

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We are pleased to support this report. This builds on Jupiter's longstanding engagement with CDP but also reflects our view that their focus on the Capital Goods sector is particularly timely. We recognize the challenges highlighted by the FSB's Task Force on Climate-related Financial Disclosures (TCFD), including the variability of climate-related impacts across and within different sectors and markets.

As long-term active investors, helping to develop thought-leadership that advances the understanding of risks and opportunities related to climate change aligns with the commitment to investor stewardship we have made to our clients.

Stephen Pearson,
Chief Investment Officer,
Jupiter Asset Management

This report as part of our investor research series has been produced independently and solely by the CDP Investor Research Team. CDP's sector research for investors provides the most comprehensive climate and water-related data and analysis on the market. The Extel IRRI survey ranked CDP the number one climate change research house for the third year running in 2017. Investment Week also awarded it best SRI research for 2016 and 2017.

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Linking climate-related metrics to earnings for Capital Goods companies

This is CDP's initiation report on the Capital Goods sector. It ranks 22 of the largest publicly listed Capital Goods companies on business readiness for a low-carbon economy transition. The companies fall into three sub-categories within the sector:

- Electrical Equipment
- Industrial Conglomerates
- Heavy Machinery

We cover around 22% of the listed global Capital Goods companies in these sub-sectors by market cap. These companies have global activities covering all regions including the growing end markets in emerging markets.

The Capital Goods sector is not an emissions intensive sector from direct emissions (Scope 1) and indirect emissions from energy use (Scope 2). However, like Autos, this is a sector where Scope 3 emissions really matter, particularly in the Use of Sold Products and it is this intensity that needs to be measured and targeted for reduction for the sector to play a key decarbonization role.

The Capital Goods sector provides the products, processes and technologies to key high emitting sectors: power generation, building products, transportation, industry and consumer appliances.

All the end markets supplied to by the sector face increasing regulation and decarbonization targets, from building and appliance standards, to mandated technologies for power generation.

This offers significant scope for the sector to use technology trends in electrification, digitalization and autonomy to change the emissions profile of end markets. Companies with business models aligned particularly to electrification, should continue to benefit from a move to meet targets set by the Paris Agreement.

There are three key areas assessed in the League Table, which are aligned with recommendations for company reporting from the G20 Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD):

Transition risks: We assess companies' disclosure and exposure to Scope 3 emissions intensity, manufacturing emissions and their business resilience.

Transition opportunities: We assess companies' positioning to capitalise on the significant revenue potential for decarbonization themes, differentiating models aligned to incremental vs. transformative change.

Climate governance and strategy: We analyse companies' governance frameworks including emissions reduction targets and the alignment of governance and remuneration structures with low-carbon objectives.

Key findings

- **Emissions in the value chain are key for the sector,** with over 90% of emissions in Scope 3 and the majority of these related to Use of Sold Products.
- **Disclosure and management of Scope 3 emissions is low and lagging the Autos sector** where Scope 3 emissions (fleet emissions) are directly regulated.
- **32% of companies have a Scope 3 emissions reduction target** compared to 81% for Autos.
- **Scope 1 + 2 emission intensities remained flat over 2012-17** but are relatively small.
- **Significant revenue opportunities are available to the sector based on low-carbon technologies** aligned with mega-trends in transitioning to a low-carbon economy.
- **The biggest opportunity set available to the sector relates to electrification,** with products linked to micro-grids, energy storage, distributed renewable generation and connectivity expected to see fast growing end markets.
- **A number of companies in the sector have products and solutions (hardware and software) with the potential to be radical and transformative, enhanced by digitalization platforms** – these include smart technologies, behind the meter solutions and precision agriculture.
- **Automation is another big opportunity for the sector to drive industrial efficiency including energy efficiency,** however, this does not offer a step change for industry to decarbonize.
- **R&D expenditure as a proportion of sales is high at 3.5% on average compared to other industrial sectors and closer to autos** – another sector being driven by technology opportunities.
- **For a sector that is set to benefit from low-carbon revenues, board level climate expertise is low.**
- **The sector is not directly regulated for Scope 3 emissions. Regulatory pressure will come through its end markets** – power, transport, buildings and major industry sectors – all high carbon emitters.
- **Products with short cycles combined with high margins offer the most business resilience** – the electrical goods sub-sector is positioned well for this trend.
- Highest ranked companies in **Electrical Equipment** are **Schneider Electric, Mitsubishi Electric and ABB.**
- Highest ranked in **Industrial Conglomerates** are **Vestas, Siemens and Honeywell.**
- Highest ranked companies in **Heavy Machinery** are **CNHI, Kubota, and Hitachi Construction.**

The summary League Table below presents headline company performance and ranking. It is based on detailed analysis across a range of climate related indicators which could have a material impact on company performance. The League Table is designed to serve as a proxy for business readiness in an industry which will have significant opportunities as governments increase efforts to implement the Paris Agreement. Companies placed towards the bottom are deemed less prepared for a low-carbon transition.

Figure 1: League Tables summaries

Electrical Equipment

League Table rank	Company	Ticker	Country	Average market cap 06/17-05/18 (US$bn)	League Table weighted rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
1	Schneider Electric	SU FP	France	50.3	2.49	1	2	1
2	Mitsubishi Electric	6503 JP	Japan	34.3	2.63	2	1	2
3	ABB	ABBN VX	Switzerland	54.0	3.90	8	3	5
4	Eaton	ETN US	USA	34.5	4.50	4	5	4
5	Johnson Controls International	JCI US	USA / Ireland	36.0	4.82	3	8	3
6	Nidec	6594 JP	Japan	40.3	4.92	5	4	6
7	Rockwell Automation	ROK US	USA	22.9	5.47	6	7	7
8	Emerson Electric	EMR US	USA	42.0	5.86	7	6	8
Weighting						**30%**	**45%**	**25%**

Source: CDP

Industrial Conglomerates

League Table rank	Company	Ticker	Country	Average market cap 06/17-05/18 (US$bn)	League Table weighted rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
1	Vestas	VWS DC	Denmark	16.8	2.35	1	2	1
2	Siemens	SIE GR	Germany	116.2	3.01	3	1	2
3	Honeywell	HON US	USA	110.1	3.49	4	3	3
4	Kawasaki Heavy Industries	7012 JP	Japan	5.5	4.54	2	6	5
5	Mitsubishi Heavy Industries	7011 JP	Japan	13.1	4.63	7	4	6
6	General Electric	GE US	USA	172.0	4.69	6	5	7
7	Wärtsilä	WRT1V FH	Finland	13.1	5.17	5	7	4
Weighting						**30%**	**45%**	**25%**

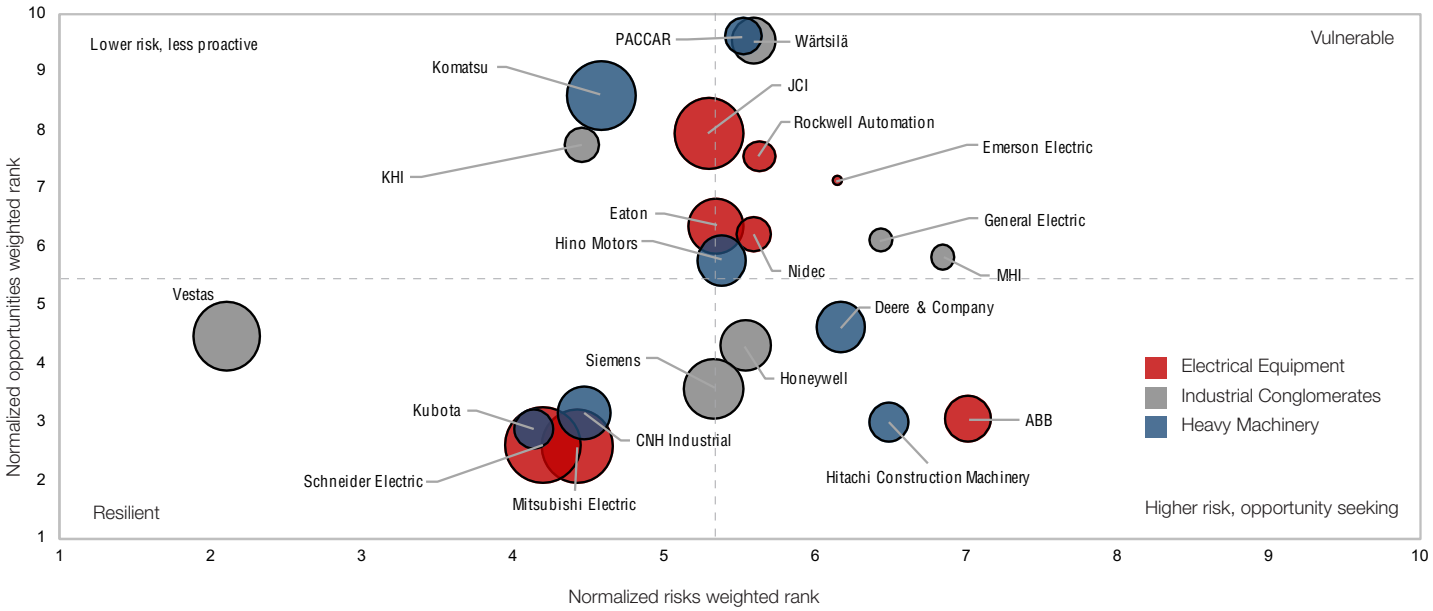
Source: CDP

Heavy Machinery

League Table rank	Company	Ticker	Country	Average market cap 06/17-05/18 (US$bn)	League Table weighted rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
1	CNH Industrial	CNHI US	USA	17.1	2.80	2	3	2
2	Kubota	6326 JP	Japan	22.3	2.87	1	1	5
3	Hitachi Construction Machinery	6305 JP	Japan	7.2	3.42	7	2	6
4	Deere & Company	DE US	USA	45.5	3.72	6	4	3
5	Hino Motors	7205 JP	Japan	7.0	3.96	4	5	4
6	Komatsu	6301 JP	Japan	30.8	4.25	3	6	1
7	PACCAR	PCAR US	USA	24.1	5.43	5	7	7
Weighting						**30%**	**45%**	**25%**

Source: CDP

Figure 2: Opportunity vs risk for low-carbon transition

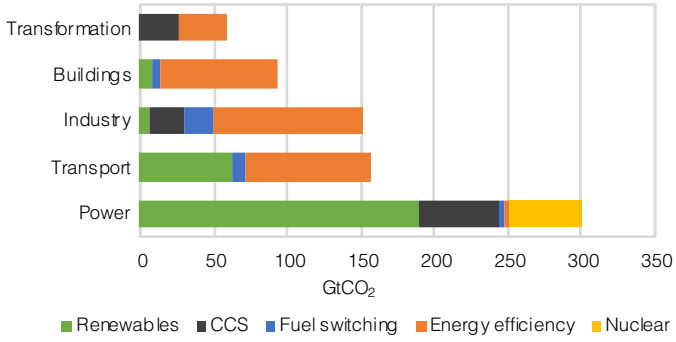


Note: Weighted rank normalized to 10
Bubble size: Larger bubble size = stronger performance on climate governance & strategy
List of abbreviation used: JCI = Johnson Controls Int.; MHI = Mitsubishi Heavy Industries; KHI = Kawasaki Heavy Industries
Source: CDP

Overview

The Capital Goods sector has the potential to offer products that can significantly alter the decarbonization pathways of the end markets they serve – power generation, transmission and distribution, building technologies, transportation, consumer appliances and industrial automation.

Figure 3: Cumulative CO_2 emissions reductions by sector and technology (IEA RTS to 2DS)



Source: IEA Energy Technology Perspectives 2017

These end markets are being driven by a combination of low-carbon regulation and disruptive technologies, shifting demand for end products. These drivers have the potential to deliver both the low-carbon technologies and efficiency gains needed to deliver decarbonization.

Efficiency is a key pillar to achieving the 2-degree scenario set out by the IEA and estimated to be US$ 236 billion[1], delivering 40% of carbon emissions abatement by 2060. These efficiency gains can be delivered either by improving the efficiency of existing technologies which are dependent on fossil fuel systems, or by shifting towards low-carbon technologies. Both will be relevant for transitioning towards a low-carbon economy, however, low/zero carbon technologies are likely to see long term sustainable gains in market demand, with fossil fuel efficiency technologies being more exposed to disruption with time frames varying by end markets.

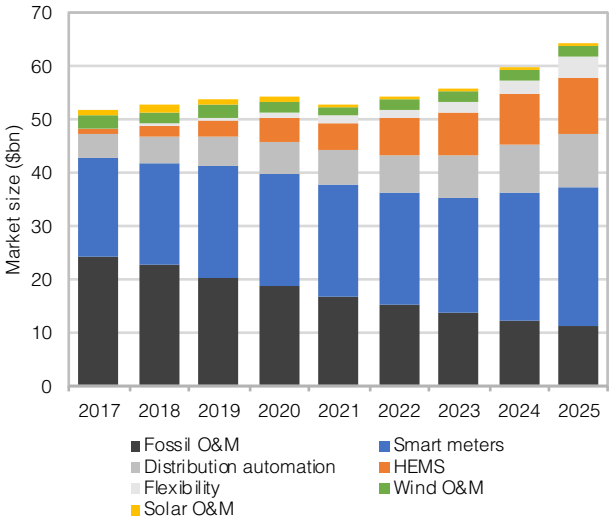
The companies in this sector are already key beneficiaries of both these trends, however, the winners are those who are proactively positioning their product portfolios to technologies that will see a step change in demand.

Here we see electrification as the main driver for change in terms of:

- Ongoing large-scale demand for low-carbon power generation – renewables, where rapid price declines put these technologies on par with fossil fuel power generation.
- Distributed generation – meeting demand for low-carbon power generation through behind the meter technologies and micro-grid solutions.
- Storage technologies that will drive faster integration of renewable technologies for centralised grids as well as increase the demand for distributed generation.
- Electrical charging facilities which will facilitate the deployment of electric vehicles both for public and private transport.
- Smart technologies in buildings which are driving the demand for connectivity between all users of power.
- Technologies that will reduce the impact of power hungry cooling appliances such as air-conditioning where demand is set to grow exponentially.
- Transmission and distribution technologies such as high voltage cables which can increase the delivery of power and reduce distribution losses.

Digitalization has been a key enabler for new technologies to be developed within the sector. While utilities have been early adopters of digitalization in managing the grid, it is the rapid developments in connectivity that would enable digitalization to disrupt the provision of centralised generation and systems through a range of decentralized smart solutions. According to Bloomberg New Energy Finance (BNEF) this opens up US$64bn in revenue for the associated value chain in energy which covers the spectrum of businesses for companies in this report.

Figure 4:Market size for digital technologies in energy (US$bn)



Source: BNEF

Automation has also been an enabling technology being offered by the sector mainly to the industrial end market from heavy carbon intensive sectors such as oil & gas, mining, cement, steel as well as healthcare and food. However, while automation brings with it efficiency gains, the gains in energy efficiency represent a smaller proportion than those related to labour productivity.

End-market business models are changing. For instance, the drive for smart metering by regulators to change consumer demand for electricity could see utilities change into more customer facing organisations offering more electricity demand management systems with products that enable greater connectivity seeing accelerated take up.

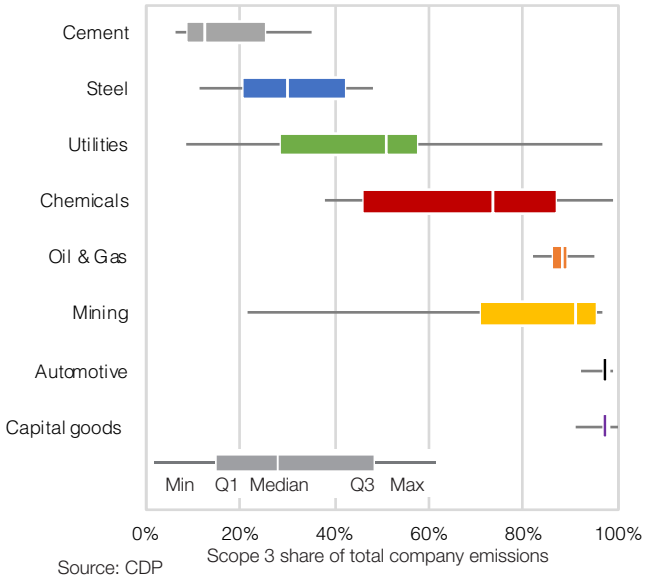
1. IEA WEI 2018

Businesses also have scope to build their own sources of power and improve the efficiency of its use. Here, take up is still in its infancy but could grow. Technology disruption in industrial markets could come from technologies from other sectors such as chemicals where hydrogen technologies are being researched for a hydrogen economy, or where CCS technologies result in existing fossil fuel power generation technologies being in place for longer – our own analysis shows that development of CCS significantly lags behind the deployment expectations in the IEA 2-degree scenarios. The pace of development of this technology has a significant impact on the power generation mix with thermal coal generation unlikely to be sustainable beyond 2027 without the technology favouring more gas and renewables in the mix.

China is a large driver for these technologies with large market shares in key technologies in end markets. In transport in 2017 China accounted for over 50% of EVs for passenger vehicles and 50% of all electric fast charging stations. In buildings for heat pumps which are the most efficient way to increase low-carbon energy for heating, China accounted for 90% of growth in sales[2].

This sector is neither intensive in terms of its operational emissions (Scope 1) or indirectly through the use of energy for their own processes (Scope 2).

Figure 5: Scope 3 as a percentage of total emissions



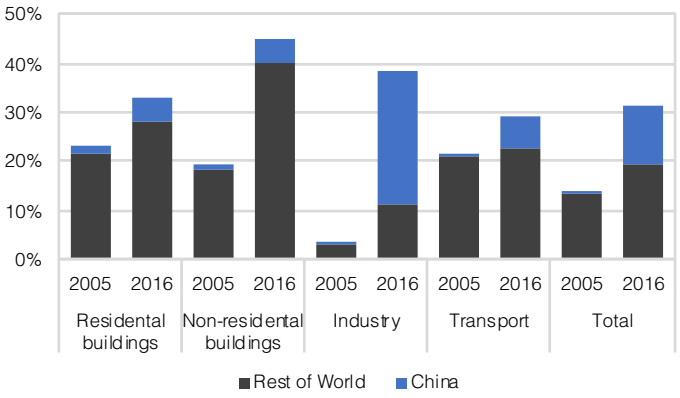
Source: CDP

The main responsibility for emissions for the sector lies in their Scope 3 (see Figure 5), either through their Purchased Goods and Services used to manufacture their products or through the Use of Sold Products. The latter is their main source of Scope 3 emissions.

While the sector is not directly regulated for these emissions, their end markets are being driven by a range of regulations, mandatory codes and standards – see Figure 6 for the IEA's assessment of levels and trends of regulatory cover for energy use by end markets.

The complexity of products, end markets and supply chains make it challenging to pin-point the sources of carbon emissions. However, the leading companies are using technical guidance provided by the Greenhouse Gas Protocol to measure these emissions and to help understand the full life-cycle impacts of their products. This is important, as regulation is likely to drive end-

Figure 6: Energy use cover of mandatory codes and standards



Source: IEA Energy Efficiency - 2017

market demand and a lack of understanding of emissions from the use of products leaves companies exposed to any disruption in demand, as witnessed in the Autos sector.

Overall, the Capital Goods sector is linked to the capex cycle of end markets with products being either short or long cycle with secular trends running through the industry. We see the need for decarbonization as a significant secular trend impacting both the short and long cycle. In this report we analyse business resilience based on margins but also exposure to short and long cycles with short cycle business arguably better placed for shifts in technology.

The companies selected for this first report on the Capital Goods sector cover three subsectors – Electrical Equipment, Industrial Conglomerates and Heavy Machinery. Within these sub-sectors, overlaps occur either, in terms of product offerings or end markets, particularly between the Electrical Equipment suppliers and the Industrial Conglomerates. These sub-sectors have product offerings that fall into different parts of the value chain and their routes to market could be direct to customers or through distributors.

Differences also arise in the three sub-sectors in terms of the pace and exposure to innovation in low-carbon technologies.

Electrical Equipment companies have a range of small to large components which go into a wide array of end products that are mainly short cycle – these have the potential to fit into the secular demand for electrification. Low-carbon technologies and those that deliver high energy efficiency are likely to see sustainable demand.

Industrial Conglomerates show varying degrees of focus on products and solutions that will be instrumental in the transition to a low-carbon economy. Some companies remain exposed to a fossil fuel core business making them less prepared to grasp the opportunities in low-carbon technologies.

The rate of innovation is lower in the Heavy Machinery group with a narrower product focus. Regulation has focused on air quality rather than CO_2 emissions and the end markets served are core economic industries less prone to disruption in fragmented industries such as agriculture and mining. Electrification and autonomy have potential but both remain at an early stage.

While demand in low-carbon technologies should benefit revenues for all three sub-sectors particularly the Electrical Equipment and Industrial Conglomerates sub-sectors, some of the growth in volumes will be offset by falling prices for technologies, for example, solar PV prices fell by 40% between 2013 and 2017.

2. IEA WEI 2018

Electrical Equipment

The group of companies in this sub-sector have a range of products to improve efficiency and capitalize on revenue opportunities.

The majority of companies have some form of transformative technology which we define as technologies that will emerge in a new dominant system in a low-carbon economy such as microgrids and behind the meter solutions. The top performers such as Schneider have technologies that are aligned with radical and transformative solutions for a low-carbon economy (see box: Digitalization and disruption of electricity markets).

A number of companies are found to be resilient with high margins, short cycle products and high growth markets protecting them from disruption in end markets.

Transition Risks

- The dominant influence on transition risks is how well companies are disclosing and performing on Scope 3 emissions as this is key for the sector (see box Emissions in the value chain are key for the sector).
- Only four out of the eight companies (Schneider, Mitsubishi, JCI, and Eaton) disclose Scope 3 emissions related to their purchased products and emissions from the Use of Sold Products (Figure 11 in transition risks).
- ABB, which performs well on Scope 1 + 2 intensities does not report on Scope 3 which is surprising given its product alignment to a low-carbon economy.

Transition Opportunities

- Seven out of eight companies have technologies which we consider to be transformative and should enjoy secular growth from demand for these technologies.
- The top four of this group – Schneider, ABB, Mitsubishi Electric and Eaton have technologies which are predominantly transformative and radical, positioning them well for long term sustainable growth.
- The bottom half of the group have a number of incremental technologies with Rockwell having 60% from technologies which are incremental.

Strategic Positioning for Long Term Carbon Resilience

- The group overall shows good resilience based on their product suite, high margins and investment in R&D.
- Schneider are the outstanding performer showing good performance across a number of metrics, with high exposure to radical and transformative technologies, good disclosure on Scope 3 emissions and low emission intensities as a result of its software businesses.
- Mitsubishi Electric is a close second with the largest portfolio of low-carbon products and also filed the largest number of high quality patents.
- Schneider is the only Capital Goods company to financially incentivize climate-risk management in long-term bonus schemes.
- No companies apart from Eaton and Schneider have any form of short-term climate-related remuneration targets.
- Emerson, who do not perform as well in our product innovation metric are also the worst performing company on board level climate management with a climate committee absent at both the board and executive levels.
- Only Mitsubishi Electric has a comprehensive Scope 3 emission reduction target. Schneider, Eaton and Mitsubishi Electric have committed to set a science-based target within the next two years.

Industrial Conglomerates

The sub-sector still remains exposed to fossil fuel energy, with around a third of revenues on average derived from fossil-fuel power and oil & gas. On the other hand, all companies are producing technologies key to enabling decarbonization trends. Leaders (Vestas, Siemens, Honeywell) integrate transition themes at the core of their strategy and are well positioned to benefit from the decarbonization of the power sector.

On the risks side, disclosure of Scope 3 emissions is still minimal, with only Vestas and Kawasaki (KHI) providing full reporting. Profit margins vary across businesses, with compressed margins in fossil fuel energy and higher margins in digital/automation solutions and healthcare. Governance also varies widely, with leaders showing good incorporation of climate-factors compared to laggards.

Transition Risks

- Only two companies (Vestas and KHI) report on Scope 3 emissions (Purchased Goods and Use of Sold Products). Vestas ranks first overall in this section, with strong performance in the Scope 1 + 2 and energy intensity metrics in addition to Scope 3 disclosure. KHI is ranked second.
- Vestas and Honewell perform strongly on business resilience, with both high margins and exposure to short-cycle capex or secular trends.
- Mitsubishi Heavy (MHI) ranks last, due to poor disclosure, high Scope 1+2 intensity and lower business resilience.

Transition Opportunities

- Mapping companies' business mixes against sectoral global growth trajectories in a 2-degree scenario, shows how Vestas, Honeywell and Siemens currently have the business mix with the largest growth potential, driven by renewable energy, building efficiency systems and digitalization technologies. Lowest growth potential is found in fossil fuel power generation and oil & gas, which weigh on the score for GE, MHI and KHI. Wärtsilä is also heavily exposed to the fossil fuel power sector, but the smaller size of its turbines makes it better suited for integration with renewable energy technologies.

- In our sustainability products analysis, Siemens emerges as the company with the most transformative product suite and the highest impact on sustainability. Honeywell follows at close distance.

- KHI, MHI, GE rank mid-way, each with important technologies in focus (geothermal and CCS for MHI, hydrogen and LNG for KHI, and multiple electrification / digitalization technologies for GE), but do not display the same breadth as the top scorers.

- Wärtsilä ranks lowest, although they also show focus on some ambitious technologies such as marine hybrid systems and digital platforms for micro-grids.

- In our analysis of exposure to short / long cycles and secular trends, Vestas intuitively stands out as most exposed to secular growth trends, followed by Honeywell with large exposure to short-term cycle capex.

Strategic Positioning for Long Term Carbon Resilience

- Strategically, leaders are integrating transition themes in their corporate strategy (Vestas, Siemens, Honeywell)

- Other companies are still heavily exposed to a fossil fuel energy core business (GE, MHI, KHI, WRT), with only initial or limited signs of strategic change taking place. GE's recent restructuring only goes so far in diluting the group's reliance on fossil fuel energy.

- Board level climate management is generally robust, with leaders showing strong climate-related expertise, risk management and monitoring.

- Regarding emissions targets, only Vestas and Wärtsilä have set a Scope 3 reduction target, with all other companies (excluding MHI) setting Scope 1+2 targets. Siemens targets net zero manufacturing emissions by 2030.

- No company incentivizes executives short-term or long-term bonuses with climate-related targets.

Heavy Machinery

To some extent, the subsector is locked-in to machinery running off diesel internal combustion engines. Diesel remains the most efficient fuel source for use within agriculture, mining and construction and heavy goods transportation. While regulation has focused on reducing pollutants from diesel, innovations into areas of electrification, hybridization and autonomy provide opportunities for manufacturers to go beyond incremental efficiency gains and move towards upscaling transformative technologies to align with a shift to a low-carbon economy.

Transition Risks

- Scope 3 emissions disclosure is advanced within the subsector. All bar one company report, not only on Use of Sold Products and Purchased Goods and Services, but also on a number of other Scope 3 categories.

- EBITDA margins are generally lower compared to companies within the other sub-sectors. Sales of new equipment are often done at very low margins, with companies targeting the provision of parts and servicing.

- CNHI and Kubota rank top, Komatsu and PACCAR rank in the bottom two.

Transition Opportunities

- Themes running through the machinery group include electrification of Heavy Machinery and heavy-duty vehicles, circularity through the provision of remanufacturing and autonomy.

- CNHI leads the Heavy Machinery group with the largest portfolio of low-carbon products.

- Hitachi Construction ranks first for the total number of patents filed, with 56% focusing on technologies that relate to the electrification of construction and mining machinery.

- Average R&D expenditure as a proportion of sales sits around 3% for the sector.

Strategic Positioning for Long Term Carbon Resilience

- Companies exposed to relatively traditional and fragmented end markets such as mining, and agriculture, operating across geographies and producing machinery for use within multiple industries are more resilient to disruptive forces.

- Companies long-term strategic position must keep abreast of tightening emissions regulations across regions, especially within the HGV sector.

- Companies that are able to upscale and commercialize transformative technologies such as fully electric vehicles and advanced levels of autonomy will be best placed to position themselves for a transition to a low-carbon economy.

- Four of the seven Heavy Machinery companies have set a Scope 3 targets relating to the Use of Sold Products. In particular, Komatsu's target covers 100% of use of sold product emissions and is the only company in our Capital Goods sample to have been approved by the Science Based Targets Initiative[3].

- Only three of the seven machinery companies display any form of climate-related remuneration with none of them incentivizing executives short-term or long-term bonuses with climate-related targets.

3. The Science Based Targets Initiative facilitates the setting of targets that are in line with the level of decarbonization required to keep global temperature increase below 2°C compared to preindustrial levels. For more information visit: sciencebasedtargets.org

Company selection and classification

Companies were selected from the largest publicly listed Capital Goods companies, based on 2017 market capitalization and those that responded to CDP's 2017 climate change information request. We formed three company groups following the GICS categorization: Electrical Equipment, Industrial Conglomerates (which includes companies from the GICS categories Industrial Conglomerates and Industrial Machinery) and Heavy Machinery (which includes companies from agricultural machinery, construction and mining machinery and HGVs[4]). These companies include Capital Goods products and services in conventional as well as new technologies. In the Industrial Conglomerates, we included Vestas (categorized in Electrical Equipment by GICS) despite its business model solely focused on wind energy because we wanted to provide a reference for the renewables divisions of GE, Siemens and MHI. In Industrial Conglomerates, we also included Wärtsilä (categorized in Industrial Machinery by GICS) because of the role it plays globally in fossil fuel power generation, third after GE and Siemens in the <500MW market. Regarding GE, we scored the company based on its current structure, although in specific metrics we gave a qualitative comment on the implications of the new proposed structure.

Non-responding companies

We highlight the following companies as non-responders to CDP's 2017 climate change questionnaire who are therefore not included in this report. We encourage investors to raise this lack of transparency in discussions with company management.

Figure 7: Non-responder to CDP

Company	Sub-sector	Ticker	Stock exchange listing	Average market cap 06/17-05/18 (US$bn)	First approached by CDP	Public disclosure of emissions(i)	Products and services
Ametek Inc.	Electrical Equipment	AME US	New York	16.1	2014	No	Electronic instruments and electromechanical devices.
CITIC Limited	Industrial Conglomerates	267 HK	Hong Kong	43.0	2006	No	Power, mining and industrial equipment with up and downstream operations in mining and power generation.
Caterpillar Inc.	Heavy Machinery	CAT US	New York	81.3	2003	Yes	Construction, mining, agricultural and industrial machinery, engines, and financial products.
MAN SE	Heavy Machinery	MAN GR	Frankfurt	16.6	2006	Yes	Trucks, buses, vans, diesel engines, turbomachinery, and specialised gear for transport and energy sectors.

(i) Emissions disclosure relates to CO_2 emissions
Source: CDP

Linking our findings to investment choices

We recognize that investment decisions are based on a multitude of different factors and that some of these can be misaligned with emission-reduction efforts. Our League Table identifies company readiness for the transition to a low-carbon economy and the physical impacts of climate change. We would flag that companies towards the bottom of our League Table are higher risk investments from a climate change perspective than those towards the top.

Figure 8: A summary of key areas, associated metrics and weights within the League Table

Key area in League Table	Financial impact	Metrics	Metrics weighting	Key area weighting
Transition risks	• Tightening downstream emission regulation could change demand for end products and impact revenues. • Emissions and energy intensities are small of this sector with limited impact on costs. • High margins and diversification in high growth markets improve resilience.	• Scope 3 emissions disclosure and intensity • Scope 1&2 emissions intensity of operations • Energy intensity of operations • Business resilience	50% 10% 10% 30%	30%
Transition opportunities	• Opportunity for new revenue streams from low-carbon products and supply of low-carbon technologies. • Improving the long term revenue stream by shifting from markets which are disrupted by low-carbon technologies. • Investment in R&D to protect incumbents from new entrants and disruptive technologies. • Increasing profitability and valuation through early-exposure to high growth markets.	• Low-carbon product scorecard • R&D % of sales • Patent analysis • *Divisional breakdown (Industrial Conglomerates only)*	70% (40% for IC) 15% 15% *30% (for IC only)*	45%
Climate governance & strategy	• Ambition level of target setting and strength of climate governance provides insight on companies' strategies to capitalise on climate-related opportunities.	• Emissions reduction targets scorecard • Supplier engagament • Board level climate expertise & management • CDP score • Climate-related remuneration • Use of internal CO_2 price	25% 25% 25% 10% 10% 5%	25%

Source: CDP

Methodology

We score each company based on a number of metrics which are ranked and then weighted within each key area (see table above for metric weightings within each key area). We then assign traffic light colors based on these weighted ranks. We calculate the overall League Table score by collating the weighted ranks for each key area. Each of the key areas has a separate chapter within this report.

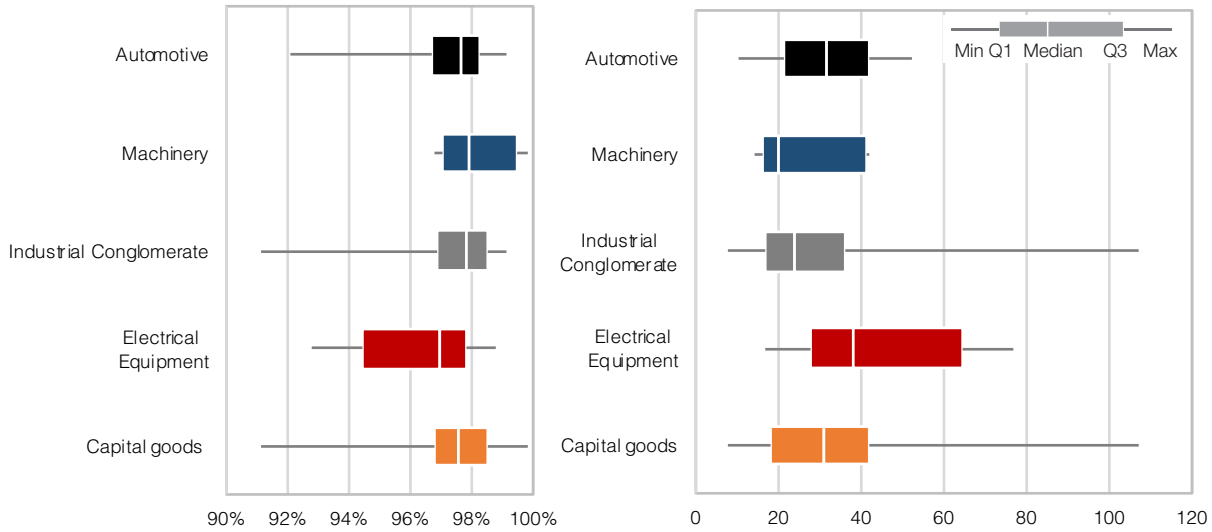
4. Within the Industrial Machinery GICS classification we focused on Mobile Heavy Machinery.

Overview

In this section, we seek to identify companies that are more exposed to risks from their value chain in terms of two key categories of Scope 3 emissions – Use of Sold Products and Purchased Goods and Services. The former category is key to the sector's position in delivering carbon savings through their products in the end markets where decarbonization needs to take place – power generation, transmission and distribution, transport, buildings (both commercial and residential) and household consumption through the use of appliances. Use of Sold Products is the largest category of Scope 3 emissions, at a multiple of the Scope 3 emissions in Purchased Goods and Services, the second biggest category.

While we stress the importance of Scope 3 emissions in our analysis we recognise that methodologies adopted are evolving so we assess Scope 3 exposure by rating companies on their disclosure as well as the level of intensity. We assess the level and trend of manufacturing emissions (Scope 1 and 2) and energy intensity, though these are relatively insignificant compared to performance on Scope 3 disclosure and intensity. In addition, we look at how well companies are positioned for changes in end market demand, looking at operating margins, product exposure to short, long and secular trends and exposure to high growth markets.

Figure 9: Share of Scope 3 and operational emission intensity



We assess transition risks using the following four metrics:

Metric 1) Scope 3 emissions performance (50%): This metric evaluates how well companies rank in terms of Scope 3 disclosure and intensities – we compile this metric based on companies' disclosure of category 1 and 11 (i.e. Purchased Goods and Use of Sold Products) of Scope 3 emissions defined by the GHG protocol. The intensity of their Scope 3 emissions is based on data disclosed to CDP or CDP's GHG Modelled Emissions Dataset.

Metric 2) Emissions intensity (10%): This metric identifies the companies with the lowest current Scope 1 and 2 emission intensity levels and evaluates the extent to which companies have reduced their operational emissions intensity over the period 2012-2016/2017 (the latest available year). Gross emission intensities are normalized by revenues and cost of goods sold.

Metric 3) Energy Intensity (10%): This metric identifies the companies with the lowest energy intensity and how much this has been reduced over the period 2012-2016/2017 (the latest available year). Energy use is normalised by revenues and cost of goods sold.

Metric 4) Business Resilience (30%): This metric evaluates how well companies are positioned to changes in end market demand. We look at EBITDA margins, the proportion of revenues exposed to short, long-cycle capex and secular trends and companies' exposure to high growth markets.

Overall highlights

- Given the importance of Scope 3 emissions (see Box Scope 3 emissions in the value chain are key for the sector) we are disappointed to see the level of disclosure from companies in the Electrical Equipment and Industrial Conglomerates sub-sectors (in the two key categories) limited to four of the eight companies for the former and two out of seven for the conglomerates. Levels of disclosure within the Heavy Machinery sub-sector are far greater with seven of the eight companies reporting on Use of Sold Products and a number of other Scope 3 categories.
- Schneider, Vestas and Hino top the three categories for Scope 3, with both good disclosure and low levels of intensity. Emerson, GE and Deere rank bottom, with no disclosure and high estimated Scope 3 emissions.
- On Scope 1 + 2 emissions, ABB, Vestas and Hitachi show the best performance, with low levels of emission intensity and declining trends over the past 5 years. JCI, KHI and Deere rank bottom.
- Emerson, Vestas and Komatsu perform best in energy intensity, again with low absolute levels and declining trends. Johnson Controls Int, Kawasaki and Deere rank bottom.
- On business resilience, Rockwell, Vestas and Kubota rank top, driven by a combination of high margins and exposure to short-cycle capex and secular trends. ABB, Wärtsilä and Hitachi rank bottom, due to lower margins and relatively high exposure to long-cycle capex.

Electrical Equipment

- The companies with the best disclosure in terms of Scope 3 emissions ranked best in this sub-sector – Schneider, Mitsubishi Electric, JCI and Eaton (Figure 13).
- The three companies that do well in this group in terms of Scope 1 + 2 emissions intensity (ABB, Rockwell and Emerson) all perform poorly on Scope 3 emissions disclosure and intensity.
- Schneider is the best performer overall with good disclosure on Scope 3 emissions and low Scope 3 emissions intensity given 44% revenue exposure to software.
- ABB ranks the worst – the company has the best performance on Scope 1 + 2 intensity but its ranking is impacted by poor disclosure on Scope 3 emissions and does not have the cushion as other companies in the group in terms of margins and exposure to short cycle revenues (Figures 15 & 16).
- Companies with high short cycle exposure combined with high EBITDA margins in the mid to upper teens, show the highest business resilience (Rockwell, Emerson, Nidec and Eaton).
- Business Resilience is further boosted for the sector through diversification into high growth markets (Figure 17).
- Scope 1 + 2 intensity levels are generally low for the sub-sector and are a fraction of the levels for their industrial customer base – intensities range between 20 - 80 tCO_2/$m of revenue compared to oil and gas or mining at around 1,000 tCO_2/$m.
- Apart from ABB who have shown a 2.7% decline p.a. in Scope 1 + 2 intensities since 2012, the rest of the group has seen Scope 1 + 2 intensities increase (Figure 11).
- Exposure to software services also provides a cushion to intensity levels with Rockwell and Schneider benefitting from this.

Figure 10: Electrical Equipment - Transition risk summary

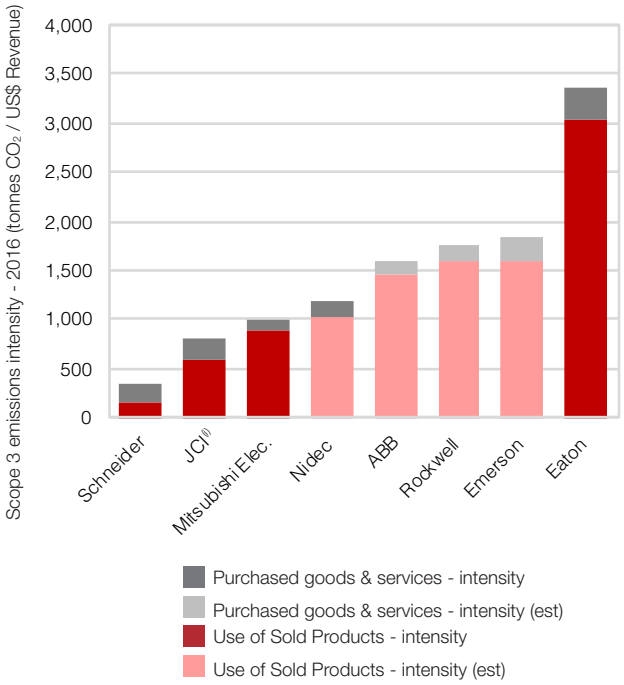
Company	S3 Intensity & Disclosure	S1+2 Emissions Intensity	Energy Intensity	Business Resilence	Overall weighted rank	Rank
Schneider Electric	1	3	3	6	3.4	1
Mitsubishi Electric	3	5	2	5	3.5	2
Johnson Controls International	2	8	8	7	4.2	3
Eaton	4	6	5	4	4.3	4
Nidec	5	7	7	3	4.5	5
Rockwell Automation	7	2	6	1	4.5	6
Emerson Electric	8	4	1	2	4.9	7
ABB	6	1	4	8	5.6	8
Weighting:	**50%**	**10%**	**10%**	**30%**		

Source: CDP

Figure 11: Electrical Equipment – Scope 3 transparency and intensity

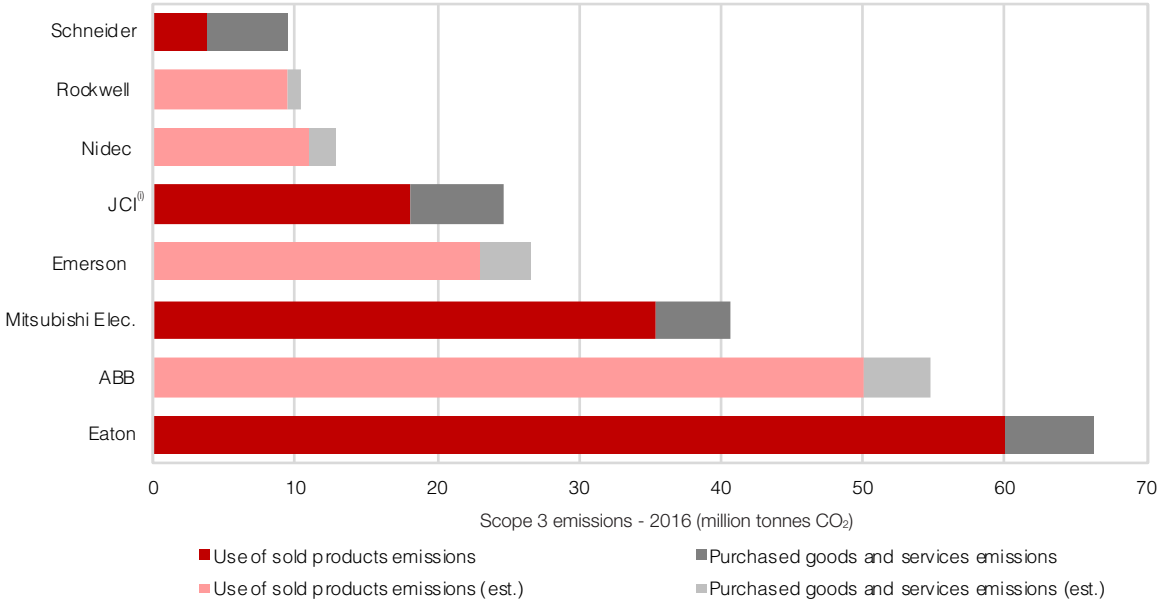
Company	Use of Sold Products	Purchased Goods and Services
Schneider Electric	✓	✓
Johnson Control Intl.	✓	✓
Mitsubishi Electric	✓	✓
Eaton	✓	✓
Nidec	✗	✓
ABB	✗	✗
Rockwell Automation	✗	✗
Emerson Electric	✗	✗

Source: CDP



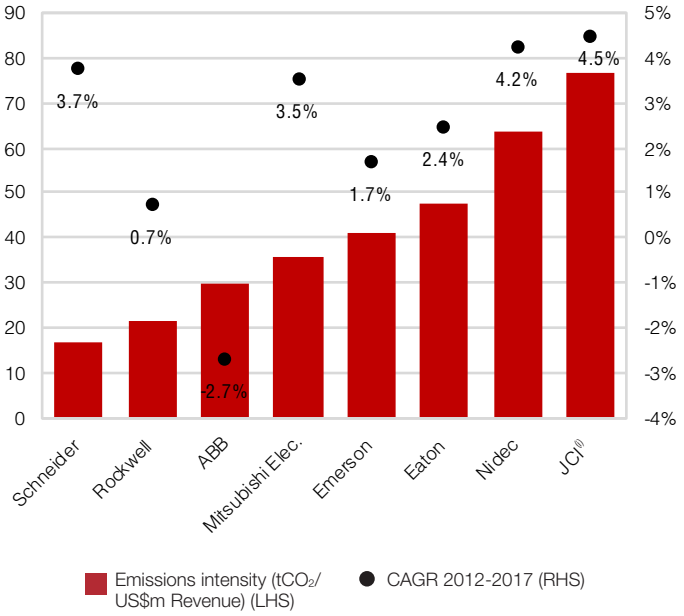
(i) 2017 data used for JCI
Source: CDP

Figure 12: Electrical Equipment – Absolute Scope 3 emissions (reported and estimated)



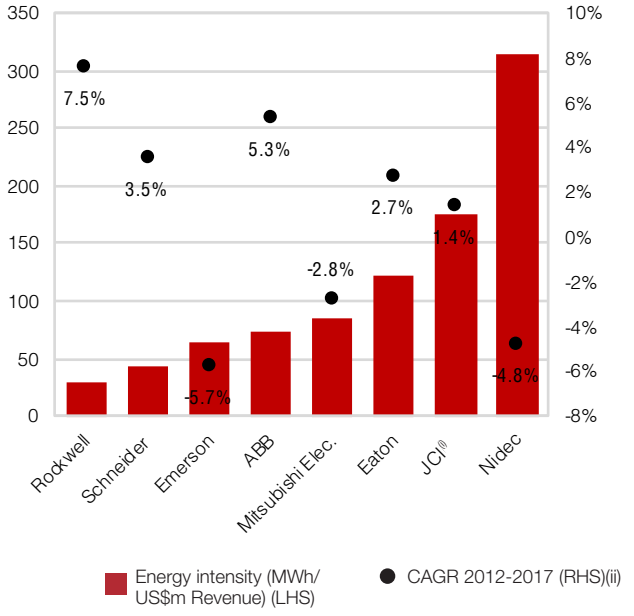
(i) 2017 data used for JCI
Source: CDP

Figure 13: Electrical Equipment – Scope 1+2 emissions intensity



Note: Most recent data points used (2016-17)
(i) Johnson Contol trend used
Source: CDP

Figure 14: Electrical Equipment – Energy intensity



Note: Most recent data points used (2016-17)
(i) Johnson Contol trend used
Source: CDP

Figure 15: Electrical Equipment – EBITDA Margins

Company	EBITDA Margin Adjusted (2015-2017)
Emerson Electric	21.8%
Rockwell Automation	20.7%
Eaton	17.0%
Schneider Electric	16.9%
Johnson Controls Intl(i)	16.8%
Nidec	15.2%
ABB	14.2%
Mitsubishi Electric	10.3%

(i) 2017 EBITDA margin used for JCI
Source: CDP, Bloomberg

Figure 16: Electrical Equipment - Product cycle scorecard

Company	Product Cycle Score
Rockwell Automation	2.46
Eaton	2.09
Nidec	2.00
Mitsubishi Electric	1.85
Emerson Electric	1.62
Schneider Electric	1.53
ABB	1.43
Johnson Controls Intl.	1.24

Source: Credit Suisse, CDP, Company Reports

Figure 17: Electrical Equipment – Exposure to high growth markets

Bubble size = revenue weighted regional growth potential score growth potential score - (score out of 10)
Source: CDP, BNEF, WorldBank, OICA, International Federation of Robotics

Industrial Conglomerates

- Scope 3 disclosure is generally poor, with only two out of seven companies (Vestas and KHI) disclosing the two key categories Purchased Goods & Services and Use of Sold Products (Figure 19). Honeywell, Siemens and Wärtsilä disclose Purchased Goods & Services but not Use of Sold Products, while GE and MHI do not disclose either of these two categories.

- On average Scope 1 + 2 emissions intensity has declined by 1.1% p.a. over 2012-16 for the group (Figure 21), with Honeywell and Vestas showing the best performance, with a high variability in results from the rest of the group. Energy intensity decreased by 0.8% p.a. over the period, with only KHI and MHI showing an increase (Figure 22).

- Vestas ranks first, performing consistently across all metrics in this section. It discloses Scope 3 emissions key categories, and ranks best in Scope 1 + 2 emissions intensity metric. It also shows the best business resilience and ranks second-best in the energy intensity metric.

- KHI ranks second, mainly due to the good level of disclosure throughout, and particularly with regard to Scope 3 emission categories, partly off-set by an increasing trend in their Scope 1 + 2 emissions and energy intensity over the period whilst also having the lowest EBITDA margins of the sub-group.

- Siemens is ranked third, performing relatively well across most of the transition risk metrics. Its Scope 1 + 2 intensity has declined by 5% p.a. over 2012-16, with energy intensity broadly flat. Its margins are average, and so is their exposure to short/long-cycle products.

- MHI ranks last, with no disclosure on the two key categories for Scope 3 emissions, Scope 1 + 2 emissions intensity increased 9.3% p.a. over the period and energy intensity was up 4.1% p.a. Its margins are among the lowest and its product suite is weighted more toward long-cycle products than its peers in the subsector.

- GE ranks second-last. They perform well on the Scope 1 + 2 emissions and energy intensity metrics, with both experiencing a material decline over the period. Their business resilience is somewhat above average but they are let down by poor disclosure on key Scope 3 emissions.

- Wärtsilä scores average on most metrics, with partial disclosure of Scope 3 categories, the second lowest Scope 1 + 2 emission intensity level but on an increasing trend, energy intensity better than average, and a product suite heavily skewed toward long-cycle products.

Figure 18: Industrial Conglomerates - Transition risk summary

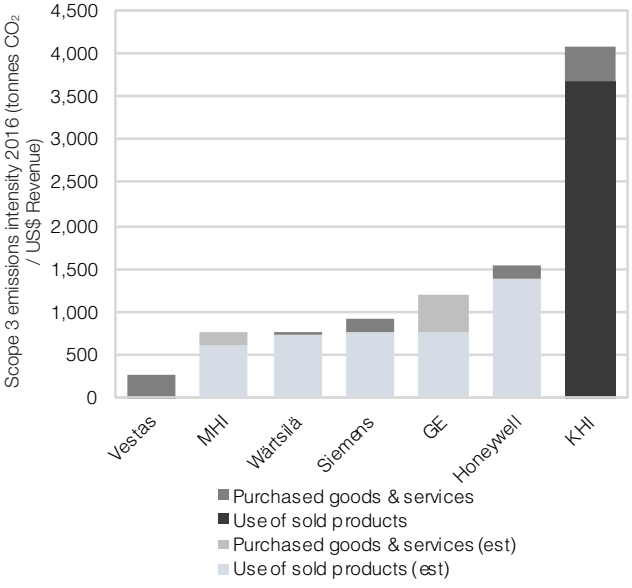
Company	S3 Intensity & Disclosure	S1+2 Emissions Intensity	Energy Intensity	Business Resilence	Overall weighted rank	Rank
Vestas	1	1	1	1	1.5	1
Kawasaki Heavy Industries	2	7	7	5	3.1	2
Siemens	4	2	3	4	3.7	3
Honeywell	5	5	6	2	3.9	4
Wärtsilä	3	4	4	7	3.9	5
General Electric	7	3	2	3	4.5	6
Mitsubishi Heavy Industries	6	6	5	6	4.8	7
Weighting:	**50%**	**10%**	**10%**	**30%**		

Source: CDP

Figure 19: Industrial Conglomerates – Scope 3 transparency and intensity (tCO_2/US$m revenue)

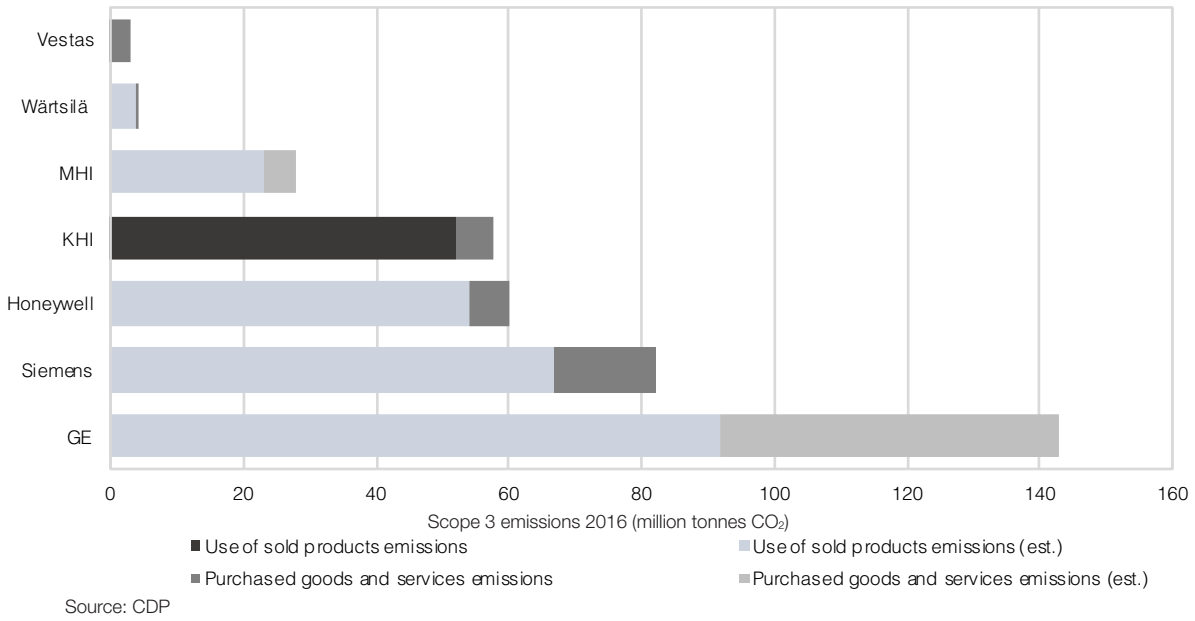
Company	Use of Sold Products	Purchased Goods and Services
Kawasaki Heavy Industries	✓	✓
Vestas	✓	✓
Honeywell	✗	✓
Siemens	✗	✓
Wärtsilä	✗	✓
General Electric	✗	✗
Mitsubishi Heavy Industries	✗	✗

Source: CDP



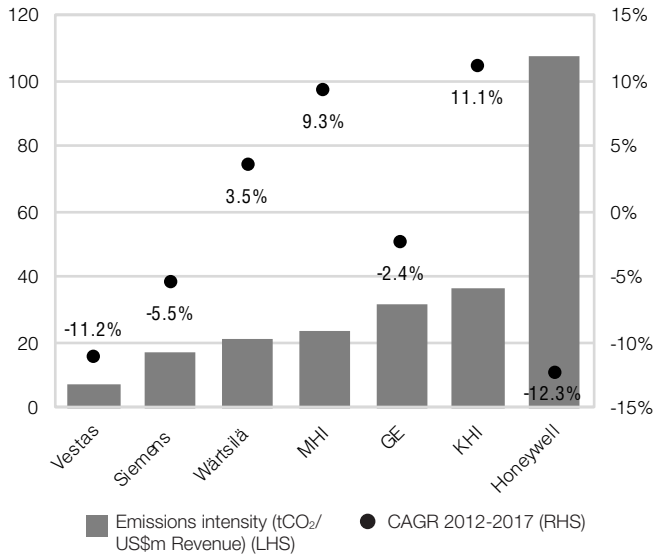
Source: CDP

Figure 20: Industrial Conglomerates – Absolute Scope 3 emissions (reported and estimated)



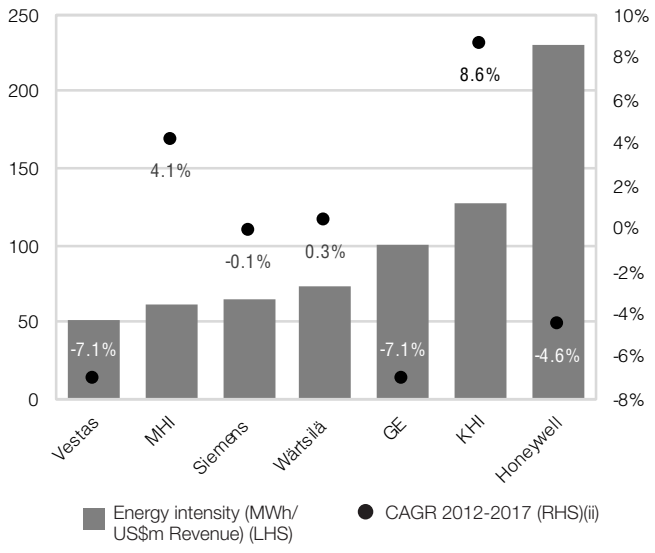
Source: CDP

Figure 21: Industrial Conglomerates – Scope 1+2 emissions intensity



Note: Most recent data points used (2016-17)
Source: CDP

Figure 22: Industrial Conglomerates – Energy intensity



Note: Most recent data points used (2016-17)
Source: CDP

Figure 23: : Industrial Conglomerates – EBITDA Margins

Company	EBITDA Margin Adjusted (2015-2017)
Honeywell	22.1%
Vestas	16.4%
Wärtsilä	14.5%
General Electric	13.4%
Siemens	12.0%
Mitsubishi Heavy Industries	10.7%
Kawasaki Heavy Industries	8.2%

Source: CDP, Bloomberg

Figure 24: Industrial Conglomerates - Product cycle scorecard

Company	Product Cycle Score
Vestas	3.0
Honeywell	2.2
Kawasaki Heavy Industries	2.1
General Electric	2.0
Siemens	1.8
Mitsubishi Heavy Industries	1.7
Wärtsilä	1.0

Source: CDP, Company Reports

Heavy Machinery

- Kubota, CNHI and Komatsu top the rankings in transition risks. Kubota performs well in the two highest weighted metrics – Scope 3 intensity and disclosure and business resilience. The company has high EBITDA margins and operates across multiple end-markets within several geographies (Figures 31 & 33). Going forward, the company will need to do more to reduce its Scope 1 + 2 emissions intensity and energy intensity in its manufacturing processes. CNHI and Komatsu perform consistently well across the four metrics.

- Scope 3 emissions disclosure is high within the sub-sector. As well as the Use of Sold Products and Purchased Goods and Services, Heavy Machinery companies show good levels of disclosure across nine of the thirteen most important Scope 3 categorizations (Figure 26).

- Driven by an enhanced regulatory framework in key end-markets (Japan, US and Europe), the two HGV manufacturers PACCAR and Hino Motors show the greatest levels of transparency in Scope 3 reporting. Hitachi Construction and Kubota have also been consistently reporting and improving disclosure of their Use of Sold Products emissions since 2010.

- Deere are the only company that currently do not disclose Use of Sold Products and Purchased Goods and Services emissions. However, the company currently undertakes life-cycle emissions analyses on new products and are looking to have their emissions from the Use of Sold Products verified by a third-party. The company also has the highest EBITDA margins and exposure to agricultural intensive areas of North and Latin America.

- Hitachi Construction ranks first and second in Scope 1 + 2 emissions intensity and energy intensity. However, the company has the second highest scope 3 intensity.

- PACCAR has the highest absolute Scope 3 emissions and the second highest Scope 3 emissions intensity with large fleets of diesel trucks in Europe and the US (Figures 28 and 27). The company's manufacturing emissions have increased 12.3% p.a. since 2012, the highest of any company.

- Two non-responding companies – Caterpillar and MAN SE – have been included in Figures 27-30 to benchmark their emissions and energy intensities against the responding companies. Figure 29 highlights that Caterpillar has the highest Scope 1 + 2 emissions intensity which has increased by 7.4% p.a.

- Scope 1 + 2 emissions intensities vary across the sector with CAGR's ranging from -11.8% to 12.3% p.a. Hino Motors has reduced its Scope 1 + 2 emissions the most, in line with its ambitious "Environmental Challenge 2050", where one its goals is to reach zero emissions in its manufacturing by 2050. We note however, that the company could improve its reporting on energy use in the manufacturing process.

- Figure 33 shows companies' revenue exposure to high growth markets in terms of agricultural production, mining exports and regions with high rates of imports and exports. Companies producing agricultural equipment and heavy goods vehicles operating in North America and Asia-Pacific rank towards the top, while companies producing mining equipment rank towards the bottom.

- EBITDA margins are generally lower compared to companies within the other subsectors, ranging from as low as 4.8% to 12.1%. Sales of new equipment are often done at very low margins, with companies relying heavily on exposure to OPEX in terms of replacement parts and servicing.

Figure 25: Heavy Machinery - Transition risk summary

Company	S3 Intensity & Disclosure	S1+2 Emissions Intensity	Energy Intensity	Business Resilience	Overall weighted rank	Rank
Kubota	4	6	6	1	2.9	1
CNH Industrial	3	4	3	3	3.1	2
Komatsu	2	3	1	5	3.2	3
Hino Motors	1	2	5	6	3.8	4
PACCAR	6	5	4	4	3.9	5
Deere & Company	7	7	7	2	4.3	6
Hitachi Construction	5	1	2	7	4.5	7
Weighting:	**50%**	**10%**	**10%**	**30%**		

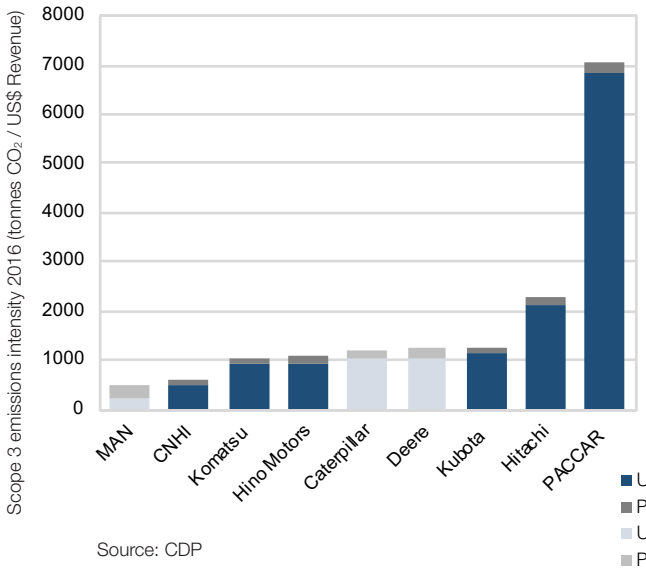
Source: CDP

Figure 26: Heavy Machinery - Scope 3 emissions transparency

Company	Use of Sold Products	Purchased Goods and Services	Upstream transportation and distribution	Capital Goods	Processing of sold products	Downstream transportation and distribution	Fuel-and-energy-related activities	End of life treatment of sold products	Waste generated in operations
Hino Motors	✓	✓	✓	✓	✓	✓	✓	✓	✓
PACCAR	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hitachi Construction	✓	✓	✓	✓	✓	✓	✓	✓	✓
CNH Industrial	✓	✓	✓	✓	✓	✓	✓	✗	✓
Komatsu	✓	✓	✓	✓	✗	✓	✓	✓	✓
Kubota	✓	✓	✗	✓	✓	✓	✓	✓	✓
Deere & Company	✗	✗	✓	✗	✗	✓	✓	✗	✓

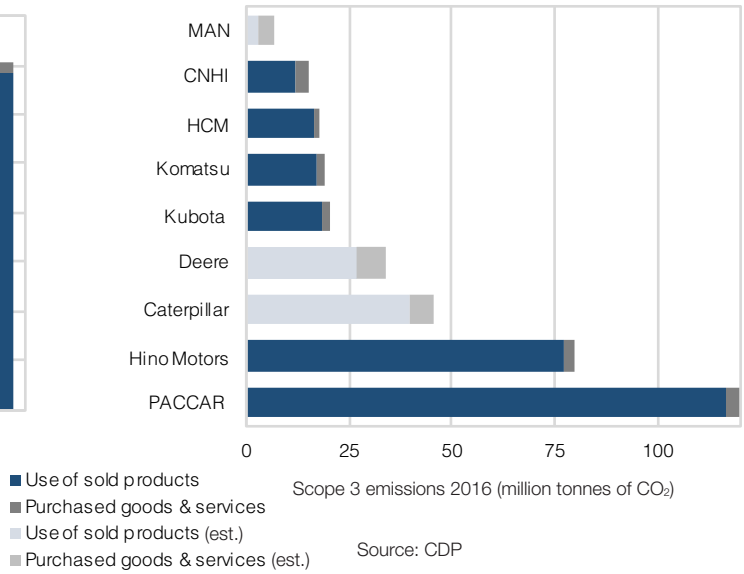
Source: CDP

Figure 27: Heavy Machinery - Scope 3 emissions intensity



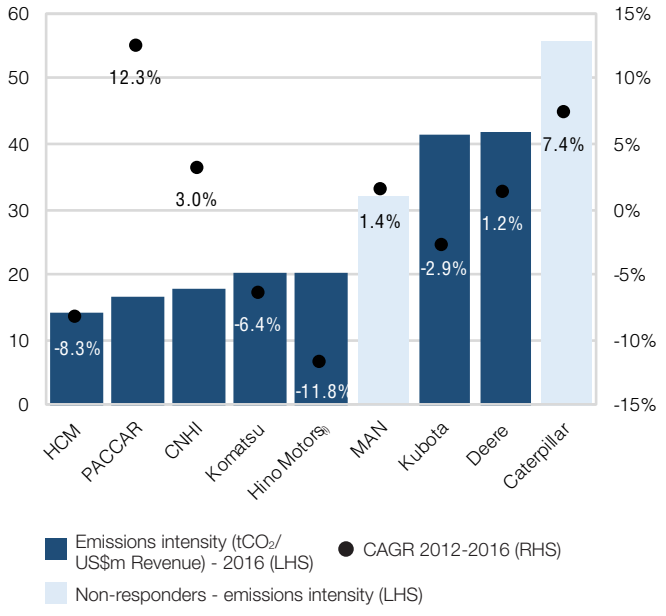
Source: CDP

Figure 28: Heavy Machinery - Absolute Scope 3 emissions



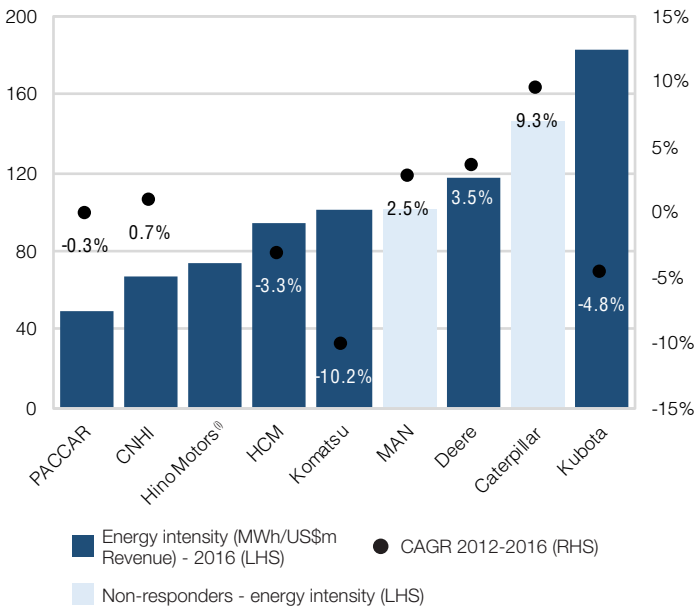
Source: CDP

Figure 29: Heavy Machinery – Scope 1+2 emissions



(i) 2015 data used for Hino Motors
Source: CDP

Figure 30: Heavy Machinery – Energy intensity



(i) Data only available for 2014-15
Source: CDP

Figure 31: Heavy Machinery – EBITDA Margins

Company	EBITDA Margin Adjusted (2015-2017)
Deere & Company	12.1%
Kubota	12.0%
PACCAR	11.5%
Komatsu	11.0%
CNHI	9.1%
Hino Motors	5.4%
Hitachi Construction	4.8%

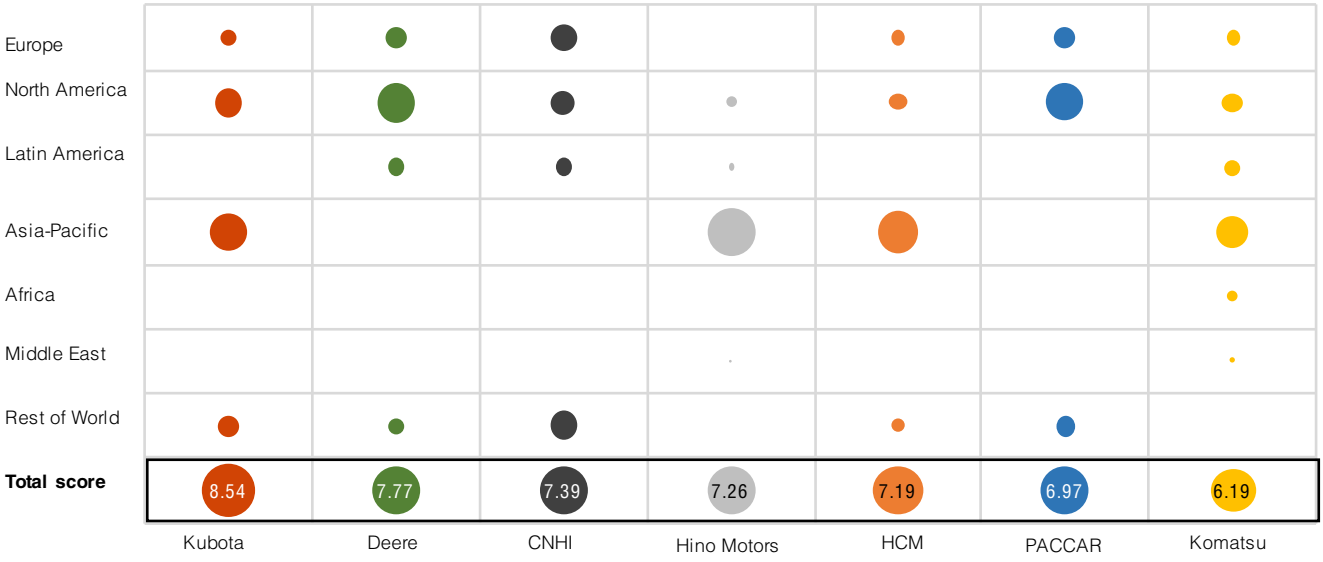
Source: CDP, Bloomberg

Figure 32: Heavy Machinery - Product cycle scorecard

Company	Product Cycle Score
Deere & Company	2.4
Kubota	2.3
CNHI	1.9
Komatsu	1.5
Hitachi Construction	1.3
Hino Motors	1.3
PACCAR	1.2

Source: CDP, Company Reports

Figure 33: Heavy Machinery - Exposure to high growth markets



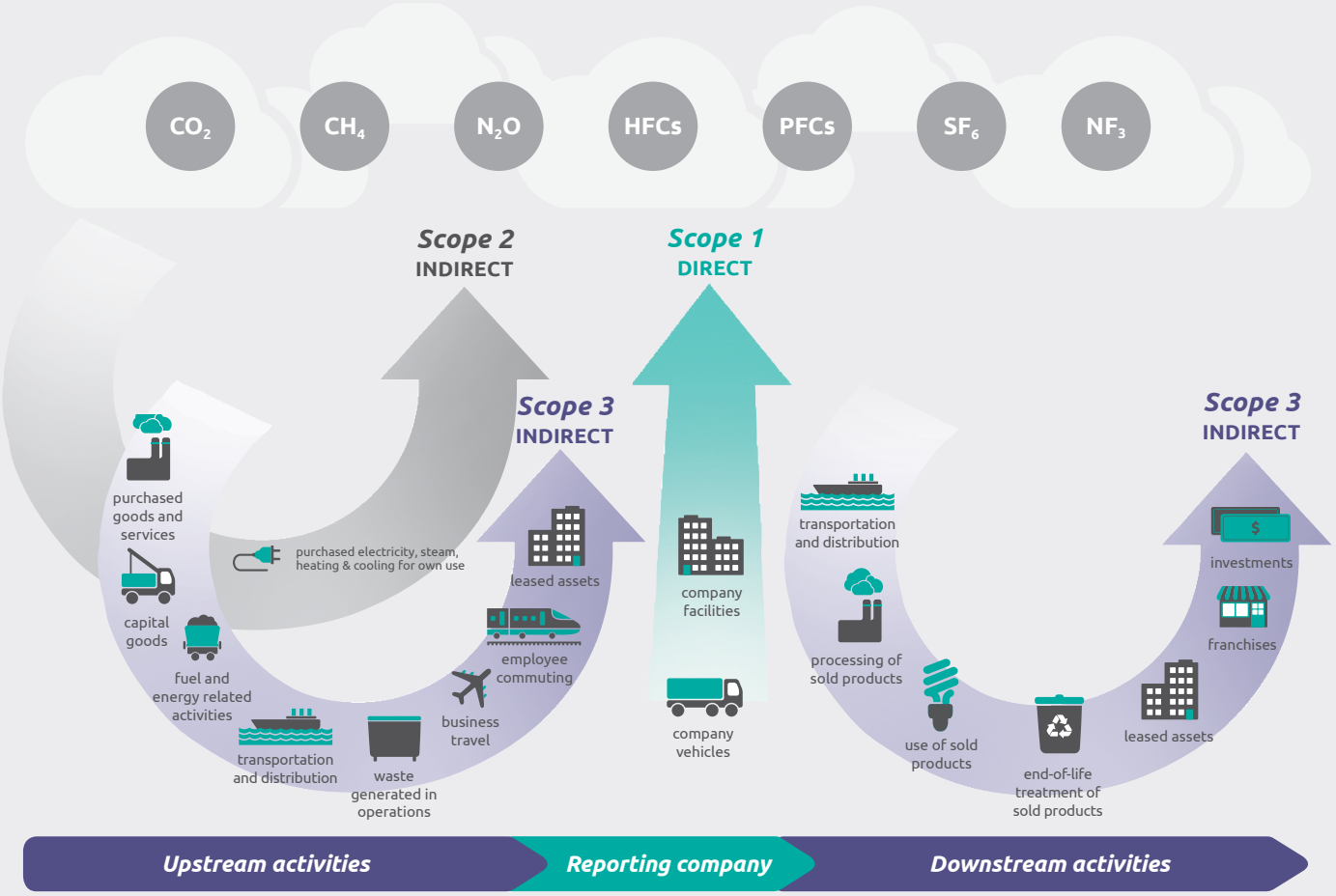
Bubble size = revenue weighted regional growth potential score growth potential score - (score out of 10)
Source: CDP, WorldBank

Scope 3 Emissions in the Value Chain are key for the sector

While most companies have started disclosing on their Scope 1 emissions (emissions from their own operations) and Scope 2 emissions (emissions from indirect energy use typically purchased electricity), Scope 3 emissions reporting is still in its infancy. Scope 3 emissions are emissions outside the operations of a company and cover the full life cycle of emissions attributable to a company's process or product often termed "cradle to grave".

The Greenhouse Gas Protocol first introduced the requirements for Scope 3 emissions in 2011 and has since published technical guidance for Scope 3 emissions and reporting in 2013 covering 15 categories in the value chain from employee commuting and business travel to emissions from Purchased Goods and Services to Use of Sold Products[5].

Figure 34 – Where different Scope of Emissions Could Arise



Source: GHG Protocol Technical Guidance Scope 3 Emissions

Most companies start their Scope 3 emissions on what they can directly measure and control, often limiting this to employee commuting and business travel. While this is acceptable for industries where most of their carbon intensity arises from Scope 1 and 2 emissions (e.g. cement, steel and metal processing such as copper and aluminum) – Scope 3 emissions are becoming increasingly important for companies where intensity comes into their business models from carbon intensive Purchased Goods and Services or from the use of products downstream.

For the Capital Goods sector, emissions from their manufacturing activities (Scope 1 and 2 emissions) are relatively low and the main emissions are attributable to Scope 3 emissions with emissions from Category 1 – Purchased Goods and Services and Category 11 – Use of Sold Products being the two categories which are key for the sector with the latter often a significant multiple of the former. It is, therefore, disappointing to find the level of reporting for this category so low across the Electrical Equipment and Industrial Conglomerate sub-sectors.

While challenges remain in measuring particularly the Use of Sold Products, life cycle analysis is crucial for this sector as this will drive both regulation for the sector and end market demand. Companies who have not initiated the process for measuring Scope 3 emissions risk potentially jeopardising products that do not meet standards or a missed opportunity for new markets. For example, with the Autos Sector – regulation of Fleet emissions (Use of Sold Products) which account for around three quarters of all emissions for the sector has meant a bigger drive for efficiency of ICE engines or adoption of advanced low-carbon vehicles to meet regulatory requirements (see CDP's report on Autos Sector - Driving Disruption – Jan 2018).

5. https://ghgprotocol.org/standards/scope-3-standard

Why CCS matters for Industrial Conglomerates

Carbon capture and storage (CCS) plays a critical role in most climate models to meet decarbonization goals set by the Paris Agreement of a temperature increase staying well-below 2-degrees. We have written about CCS in the past (Mind the CCS Gap), but here we will focus on the implications for the fossil fuel and renewable power sectors of the success or failure of CCS development.

CCS is responsible for 14% of the cumulative emissions abatement needed in the power sector between now and 2060 required to stay well below a 2-degree temperature increase (B2DS), compared to a reference scenario (RTS) where temperature rises by 6 degrees (IEA, ETP 2017). Despite the intuitive potential of CCS, implementation has been disappointing, with an already widening gap between reality and climate models expectations. Today, there are only two large-scale CCS operating plants in power generation, which capture 2.4Mt of carbon per annum and transport it for 60-130km for enhanced oil recovery (EOR). In addition, there are seven large scale projects in early development due on-line in the 20's and with a total potential capture rate of 11Mt per annum (mainly in China and South Korea). This compares to an IEA projected capture rate of 42Mt in 2025 and 350Mt in 2030 to stay within a B2DS.

Based on IEA 2017 projections, we have run a simplified sensitivity to assess the step-up that would be required between 2018-60 from either gas, renewables or nuclear (or all three together) to fill the gap left by CCS should this fail to take-off altogether, and still be able to meet a B2DS target. Below we run through the main scenarios of this analysis and key conclusions (for details on the methodology followed refer to our Mind the CCS Gap publication).

Scenario 1: replace CCS via early gas/coal switch: For this combination to work, coal would need to be retired immediately (2018), and gas-powered electricity generation would double compared to a scenario with CCS.

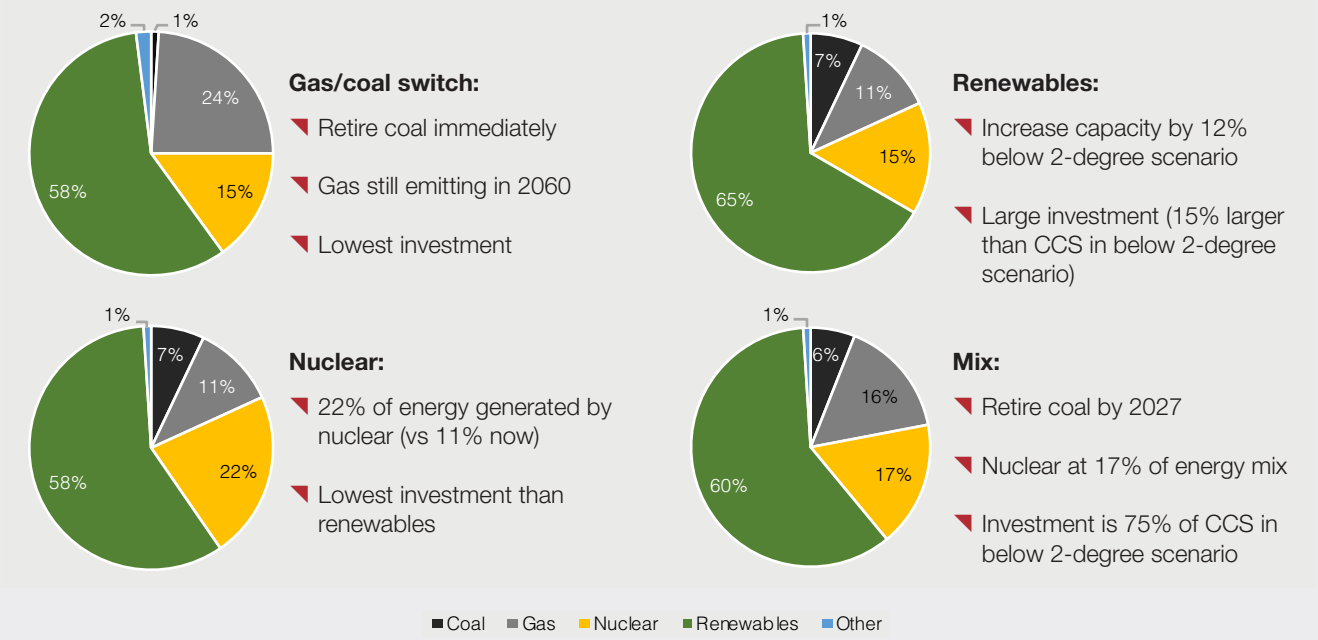
Scenario 2: replace CCS via renewables: Expanding renewables to plug the power gap left by CCS looks more promising, with a relatively contained capacity increase (12%) against the cumulative B2DS capacity and an investment approximately 15% larger than the one assumed in the IEA B2DS scenario. However the capacity ramp-up envisaged by the B2DS is already steep (i.e. 155 years of current generation in the period 2015-2060).

Scenario 3: replace CCS via nuclear: The incremental nuclear capacity required over and above the B2DS is significant, representing 43 times the 2015 global generation. Also, in this scenario almost a quarter of the 2015-2060 power generation would be generated by nuclear (compared to 11% in 2015), which would raise clear risk management and political challenges.

Scenario 4: replace CCS via a mix of the three above (33% each): Combination of the early gas/coal switch, renewables, nuclear in equal parts still looks ambitious: coal needs to be retired by 2027, renewables needs to generate 4% cumulative incremental power compared to an already ambitious B2DS, and nuclear generates 17% of cumulative power between 2015-60.

Two main conclusions stand out. Firstly, any scenario looks highly challenging, particularly as the incremental demands come on top of the already stretching assumptions made by B2DS. This highlights the risks that fossil reliant utilities and their OEMs run unless CCS development is boosted and ramped-up at scale – something for which at the moment there are no economic nor regulatory incentives. Secondly, among all four scenarios, the one heavily tilted toward renewables plugging the gap is in our view the most feasible, which should it materialise would have significant implications for renewables and T&D OEMs.

Figure 35: What would a power sector without CCS look like? (Share of cumulative power sources)



Source: CDP

Overview

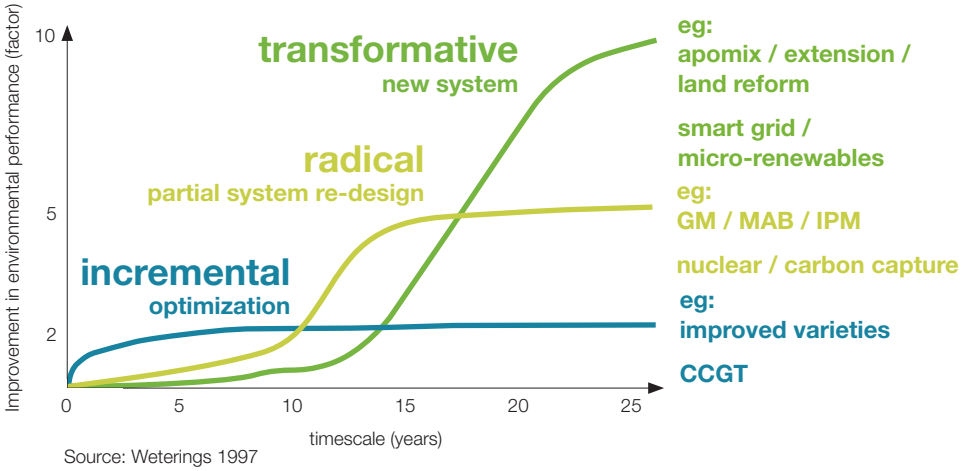
This sector offers significant transition opportunities for end markets such as power generation, transport and buildings which are looking to reduce their carbon footprint; with the sector providing a range of products at different points in the value chain, with some overlap in revenue and end markets between companies in the different sub-sectors.

The Electrical Equipment sub-sector provides both intermediate products such as sensors and inverters which go into larger end products but also provide end products and solutions to the market. Similarly, the Industrial Conglomerates have a diverse range of products that serve different end markets, but these typically are larger Capital Goods for power generation, transmission & distribution and transportation. The focus for this sub-sector is power generation, specifically the significant growth rates attached to renewable power generation to deliver the IEA 2DS – Vestas is included in this category given its role as a pure play wind power generator. The Heavy Industrial Goods sector has a narrower range of products and end markets with less innovation opportunities.

The product and service range are targeted to existing technologies that use fossil fuels as well as new low-carbon technologies. In this section, we review the product offerings in each sub-sector and use a scorecard approach to rank companies based on their portfolio of low-carbon products both in terms of level of innovation and end market growth rates.

For innovation, we evaluate technology portfolios to assess if they are 'incremental, radical or transformative' based on innovation theory[6] on how these different forms of innovation can drive change.

Figure 36: Theory of innovation



Source: Weterings 1997

The highest ranking transformative technologies were:

- Microgrids
- Energy storage systems
- Fuel cells
- Hydrogen power
- Smart grid controls
- Behind the meter technologies
- Hybrid Renewables

Figure 37 - Theory of innovation to drive change

Innovation	Definition	3 horizons equivalent
Incremental	Incremental innovations' occur more or less continuously in any industry to improve price and performance.	The 'first horizon' system losing strategic fit and therefore dominance over time
Radical	'Radical innovations' are discontinuous events, which are unevenly distributed over sectors and over time. Whenever they occur they are important as the potential springboard for the growth of new markets, and for the surges of new investment associated with booms. They often involve a combined product, process and organizational innovation.	The 'second horizon' of innovations seeking to exploit the opportunities emerging in a changing world
Transformative	'Transformative innovations' are far-reaching changes in technology, affecting several branches of the economy, as well as giving rise to entirely new sectors. It can be distinguished from 'radical' innovations in that while the latter disrupt existing technical competences, the former also involve substantial changes in markets and linkages with users.	The 'third horizon' in tune with deeper trends in society that eventually emerges as the new dominant system

Source: CDP

Our scorecard approach also evaluates and ranks technology portfolios based on the potential for end market growth by using IEA forecasts based on alignment to a 2-degree scenario between 2014 and 2040.

In addition, to using a product scorecard, we assess companies based on the level and trend of their R&D expenditure as well as the total volume of patents filed for technologies that relate to key themes for each sub-sector such as electrification, digitalization and automation.

6. Weterings (1997) System optimization versus system innovation

We assess transition opportunities by using the following metrics:

Metric 1) Low-carbon product analysis (70%): We compiled a list of low-carbon products for each company based on public reporting, company websites and CDP responses and assigned two scores to each product – End Market Score and Innovation Score. The End Market Score was derived on end market growth rates forecast by the IEA according to a 2-degree scenario to 2040. In the Innovation Scorecard we assessed products based on their incremental, radical or transformative nature. These two scores were combined to produce a overall product score and the average of the top 10 best performing products for each company was calculated to produce a company score.

Metric 1b) [For Industrial Conglomerates only] Business mix growth potential: We have included a sub-metric where divisional revenues are mapped to high growth markets as defined in the IEA 2-degree scenario where they are then scored as a function of their market growth potential. For the Industrial Conglomerates, we assign a weighting of 30% to this metric and 40% to the low-carbon product analysis.

Metric 2) R&D spend (15%): This metric looks at annual R&D expenditure as a percentage of sales where we assess both the level and trend.

Metric 3) Patent analysis (15%): This metric analyses the number of high quality patent applications submitted by companies in product categories that align with the transition to a low-carbon economy. We look at the number patents filed between 2000 – 2017, normalizing by employee numbers for each respective year and calculating a weighted sum of the total patent count. We determine the quality of the patents based on the number of citations it receives in scholarly publications.

Overall highlights

- On average, Industrial Conglomerates and Electrical Equipment companies perform almost in line with one another however Electrical Equipment companies perform across a broader range.
- Three out of the top four performing companies across all three sub-sectors are Electrical Equipment suppliers (Schneider, ABB and Mitsubishi) with the group average being brought down by laggards such as Rockwell. Industrial Equipment companies are more clustered between a score of around 50 to 80.
- The best performing company is Schneider Electric from the Electrical Equipment subsector and the worst performing company is PACCAR from the Machinery sub-sector.
- The Industrial Conglomerates provide a broad range of diversified products which feed into numerous end markets and therefore there is potentially more scope for innovation.
- Companies within the Electrical Equipment group operate at different points across the value chain relative to both the Industrial Conglomerates and each other. Often these companies provide the devices that feed into industrial conglomerate solutions.
- Machinery companies perform towards the bottom of the group, which is underpinned by the relatively narrow product portfolios of these companies, limiting the scope for innovation.
- In both the Electrical Equipment and Industrial Conglomerates subsectors a number of companies provide automation and control systems. In our innovation scorecard we differentiate between levels of automation assigning a lower innovation score to simple control and automation systems which deliver incremental efficiency gains and a higher score to more sophisticated automation infrastructures with scope for system wide change such as cloud-based solutions or internet-of-things.
- In our patent analysis, there is a general trend of Japanese companies performing well, with at least one Japanese company in the top two across each subsector. This follows a trend consistent with our Autos report where Japanese companies seem to file more patents than their peers. It is worth noting that this metric does not account for the 'incremental, radical or transformative' nature of the patents filed and therefore does not capture the impact of companies' innovative efforts.
- With regard to R&D intensity, the Electrical Equipment and Industrial Conglomerate companies are characterized by comparable R&D levels (3.5%-3.6%) but is somewhat lower for Heavy Machinery (3.2%). Rockwell and Siemens stand out as the only companies above 5% (5.3% and 5.2% respectively).

Electrical Equipment

- Given their integrated nature, the themes which emerge in this sub-sector overlap with the Industrial Conglomerate sub-sector.
- Decentralized energy, renewable energy integration, electromobility and behind the meter solutions all feature, as well as highly efficient appliances and heating and cooling systems.
- Schneider Electric has the highest score across all three subsectors with a number of transformative products supporting decentralized energy systems such as energy storage and microgrid technologies (Figure 40).
- Rockwell performs poorly in the low carbon product scorecard, with 60% of its low-carbon products representing incremental innovations such as automation and control systems that deliver efficiency improvements to industrial plants (Figure 40).

- ABB performs well on the low-carbon product scorecard, coming second based on the potential of their EV charging network as well as products to support renewable and distributed generation.
- Mitsubishi Electric has the largest portfolio of low-carbon products of all Electrical Equipment companies with Emerson found to have the lowest scoring low-carbon portfolio (Figure 38).
- Mitsubishi Electric has also filed the largest number of high quality patents with 657 (per 10,000 employees) between 2000 – 2017. More than 60% of these focus on technologies that relate to automation, connectivity and digitalization. Rockwell Automation are in second position with 91 patents, excelling in technologies that facilitate automation and energy efficiency (Figure 42).
- On R&D intensity, Rockwell ranks first with 5.3%, followed by Mitsubishi Electric with 4.6%. At the other end JCI has the lowest R&D intensity (1.2%), followed by Emerson (Figure 41).

Figure 38: Electrical Equipment - Transition opportunities summary

Company	Low-carbon Product Scorecard	R&D % Sales	Patent Analysis	Overall weighted rank	Rank
Mitsubishi Electric	2	3	1	2.1	1
Schneider Electric	1	2	7	2.1	2
ABB	2	5	3	2.4	3
Nidec	5	4	4	5.0	4
Eaton	4	6	5	5.1	5
Emerson Electric	6	7	6	5.7	6
Rockwell Automation	8	1	2	6.1	7
Johnson Controls International	7	8	8	6.4	8
Weighting	**70%**	**15%**	**15%**		

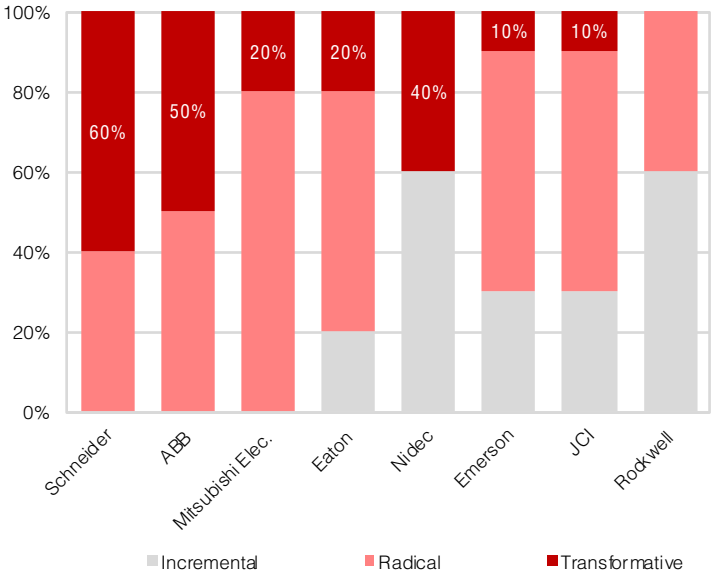
Source: CDP

Figure 39: Electrical Equipment - Low-carbon product scorecard

Company	Rank	Score	Top performing products
Schneider Electric	1	83.2	Products that support decentralized energy generation e.g. microgrid solutions and energy storage Electromobility charging solutions A range of behind the meter products and solutions Devices to support renewable energy generation or the application of renewable power to household appliances particularly for off-grid EM markets Smart IoT platforms for connecting and optimizing building and plant operations.
Mitsubishi Electric	2	76.0	Products that support decentralized energy e.g. microgrids Hardware to support renewable energy storage and grid integration Behind the meter products and solutions Smart, highly efficient appliances and heating/cooling solutions
ABB	2	76.0	Products that support decentralized energy e.g. microgrids EV charging infrastructure HVDC products Hardware to support renewable energy generation Smart IoT systems to optimize power generation and distribution, buildings and industrial plants
Eaton	4	56.4	Products that support decentralized energy e.g. microgrid solutions Hardware to support renewable and distributed energy generation Behind the meter solutions
Nidec	5	54.4	Microgrid solutions and energy storage for the provision of distributed energy EV charging infrastructure Behind the meter solutions
Emerson Electric	6	53.6	Smallest portfolio of 'low-carbon' products of all companies Behind the meter solutions Control infrastructure for power management Thermostats and heat pumps
Johnson Controls International	7	53.2	Battery solutions Smart building technologies Highly efficient heating and cooling products
Rockwell Automation	8	39.2	Control infrastructure to allows for the optimal efficiency of energy intensive industrial devices such as motors

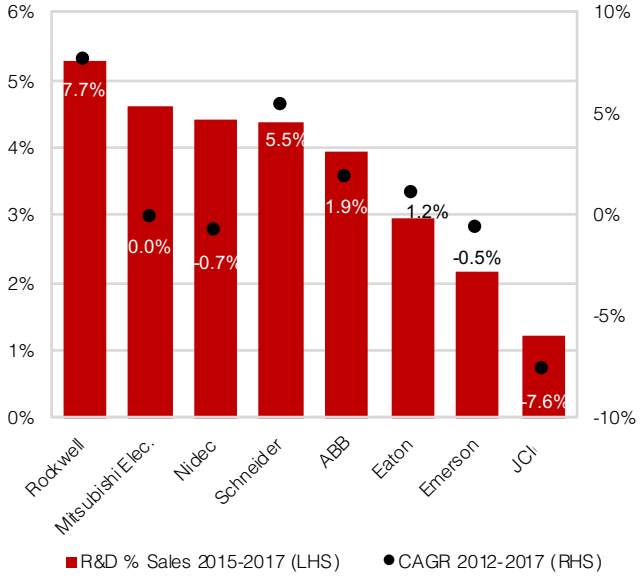
Source: CDP

Figure 40: Electrical Equipment - Low-carbon product technology split



Source: CDP, company reports

Figure 41: Electrical Equipment - R&D as % of sales



Source: CDP, company reports

Figure 42: Electric Equipment - High Quality Patents per 10,000 employees (2000 - 2017)

Name	Electrification	Energy Efficiency	Automation, Connectivity & Digitisation	Weighted total (2000-2017)	Rank
Mitsubishi Electric(i)	239	538	1,202	657	1
Rockwell Automation	34	122	119	91	2
ABB	52	55	52	53	3
Nidec	2	90	24	38	4
Eaton	9	37	12	19	5
Emerson	4	33	18	18	6
Schneider Electric	8	22	15	15	7
Johnson Controls Int(ii)	5	15	11	10	8

(i). Due to the high volume of patents for Mitsubishi Electric and limitations in the total number that could be downloaded and analysed, we took the absolute number of MEC's patents for these respective themes and divided through by the average employee numbers between 2000 – 2017. We then downloaded a sample of the data to calculate the average % of high quality patents and applied this factor.
(ii). Due to the limited number of patents for Tyco International we have focused on historic patents from Johnson Controls.
Source: Lens.org

Digitalization and disruption of electricity markets

Digital technologies have been in use for over 50 years with utilities using emerging technologies to manage the grid. Digital technologies have become the dominant form of electronics and communications and have moved from rapid data processing to connectivity and data sharing in the industrial, consumer and energy sectors[7]. Digitalization is the process of connecting devices through digital communications, collecting and sharing data and analysing that data to improve machine or system operations.

The value chain of digitalization involves:

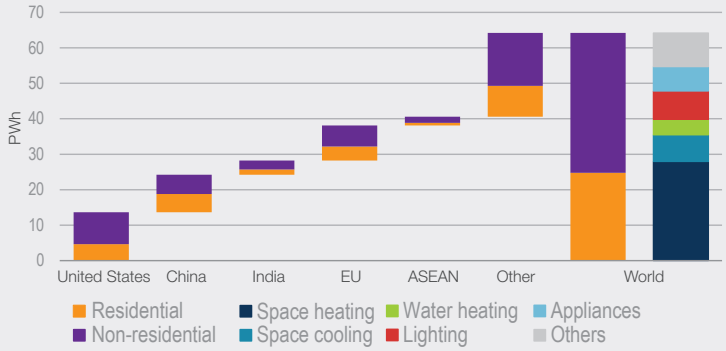
- Sensors to report data from connected machines
- Communication networks to transmit it
- Software platforms to organise and redirect selected data
- Analytics programs to generate insight and conclusions

Rapid developments in connectivity and falling costs provide significant scope to save energy by breaking down boundaries between energy sectors, increasing flexibility and enabling integration across entire systems[8].

Connected devices offer the scope to reduce energy demand through smart demand response where consumers, smart controls and connected devices reduce consumption in response to financial incentives such as time-based rates. In the IEA reference scenario, by 2040 50% of household electricity demand for appliances is expected to come from connected devices. However, this has to be accompanied by the reduction of consumption of energy by standby functions of connected devices with the energy intensity of connected devices expected to halve from 2015 levels by 2040.

Smart thermostats offer households scope to monitor and regulate heating and cooling loads with the potential for 15-50% energy savings depending on building and control technologies (IEA 2017, Grozinger et al 2017). Smart thermostat demand has doubled from 3% to 6% of total revenues from residential thermostat sales between 2014 - 2016 (IEA 2017, Wilczynski 2017) with the potential for end market revenues from smart thermostats to increase from US$1.1bn in 2016 to US$4.4bn in 2025 (IEA 2017, Navigant Research 2016).

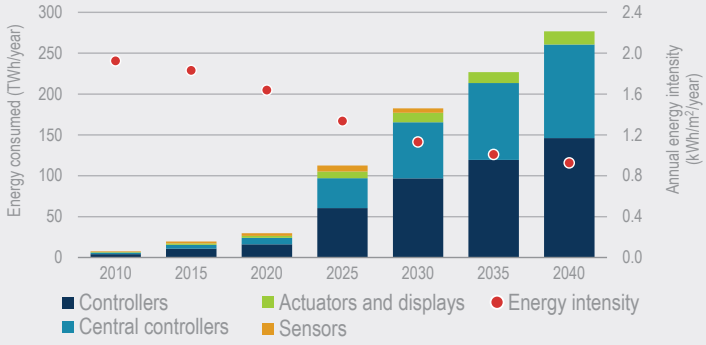
Figure 43: Energy savings in buildings from digitalization



(i) Non-residential includes buildings used for wholesale and retail trade, storage, education, health, hospitality and commercial activities, as well as offices and public buildings.

Source: IEA Digitization & energy 2017

Figure 44: Global energy use and average energy intensity of active controls in buildings



(i) Sensors include occupancy and daylighting sensors; central controllers collect data from an entire dwelling or building and monitor operating units; controllers only operate on a specific zone of the building.

Source: IEA Digitization & energy 2017

Digitalization has the potential to disrupt the provision of centralised generation and systems with a 5-year extension for power plants' networks[8] and according to the IEA 2017 report, capex savings coming from:

- **Smart demand response:** Could result in 185 GW of system flexibility saving US$270bn in new electricity infrastructure.
- **Integration of renewables in the EU:** Could reduce curtailment of solar PV from 7% to 1.6%.
- **Smart charging technologies for EVs:** Could avoid investment in the grid saving US$100-280bn between 2016 and 2040.
- **Facilitate development of distributed energy resources** such as household solar PV and storage.

Digitalization allows sectors such as the building sector to realize significant efficiency gains. Buildings account for 1/3 of global final energy consumption and 55% of global electricity consumption. In the last 25 years, buildings have contributed to 60% growth in global electricity consumption with China and India seeing strong growth over the last decade. Digitalization and widespread use of controls has the potential to reduce energy consumption in buildings by 65 PWh cumulatively to 2040 which was the global electricity consumption of buildings in 2017. The largest savings are in heating, cooling and lighting which together accounted for 60% of final energy demand in buildings in 2015.

Major heating and cooling equipment providers such as JCI, Danfoss and Honeywell are offering products that can be controlled remotely from smart phone applications.

Smart lighting which connects high performance LED lights to building control systems can offer substantial energy savings estimated at around 14% of cumulative energy savings between 2017 and 2040 in the IEA reference scenario.

While the residential sector is expected to contribute 35% of this, the rebound effect (where lower costs and improved quality could result in increased demand) could offset these gains. However, in the commercial and public places, there is a greater chance for these savings to be secured.

Barriers to adoption include privacy, technical and economic considerations – here utilities could have a role to play by offering financial incentives and introducing innovative tariff schemes

7. Digitalization of Energy Systems - Nov 2017 – BNEF
8. Digitalization and Energy – IEA – 2017

Industrial Conglomerates

- Our mapping exercise of companies' business mix against sectoral growth potential in a 2-degree scenario shows Siemens, Honeywell and Vestas in the top positions. This is driven by their renewable energy businesses efficiency solutions for buildings and industrial digitalization technologies. At the other end we find Wärtsilä, GE (pre-restructuring) and MHI, penalized by the low growth potential of power, oil and gas, and marine divisions. With the new perimeter (excluding Healthcare and Baker Hughes GE), GE would score middle of the pack, benefiting from the divestment of oil & gas but still heavily skewed toward the fossil fuel power segment.

- In our product analysis, all companies to varying degrees showed a focus on innovation in the sustainability space. The key themes emerging from the conglomerates include the provision of infrastructure to support the deployment of renewable and renewable integration to the grid, decentralized energy, the electrification of transport, and the digitalization and automation of industrial processes.

- Siemens leads the Industrial Conglomerates product analysis, providing decentralized energy systems such as storage solutions, as well as electromobility charging components, IoT and cloud-based solutions.

- Honeywell is a close second, thanks to its products for smart-grids, energy efficiency, electrification as well as green fuels.

- Vesta ranks third with solutions for solar-wind integration and storage, and digitalization of wind farms.

- KHI, MHI, GE rank mid-way, each with important technologies in focus (geothermal and CCS for MHI, hydrogen and LNG for KHI, and multiple electrification / digitalization technologies for GE), but do not display the same breadth as the top scorers.

- Wärtsilä developed solutions in solar and hybrid marine systems but ranks last in the group due to a large part of its low-carbon products being incremental innovations delivering efficiency improvements for the marine sector.

- Vestas has the largest number of patents for clean energy related technologies and is ranked in first position overall with 331 patents (per 10,000 employees). MHI is ranked in second position with 113 patents, dominating the patent count for automation, connectivity and digitization related technologies. KHI follow closely behind in third position.

- Regarding R&D, Siemens has the highest intensity at 5.2%, followed by Honeywell (4.7%) and GE (4.6%). At the other end we find MHI (2.3%), Vestas (2.4%) and Wärtsilä (2.75%).

Figure 45: Industrial Conglomerates - Transition opportunities summary

Company	Low-carbon Product Scorecard	R&D % Sales	Patent Analysis	Divisional Breakdown	Overall weighted rank	Rank
Siemens	1	1	4	3	2.5	1
Vestas	3	7	1	1	2.8	2
Honeywell	2	3	5	2	3.2	3
Mitsubishi Heavy Industries	5	4	2	5	4.2	4
General Electric	4	2	7	6	4.4	5
Kawasaki Heavy Industries	6	5	3	4	5.4	6
Wärtsilä	7	6	6	7	6.7	7
Weighting	**40%**	**15%**	**15%**	**30%**		

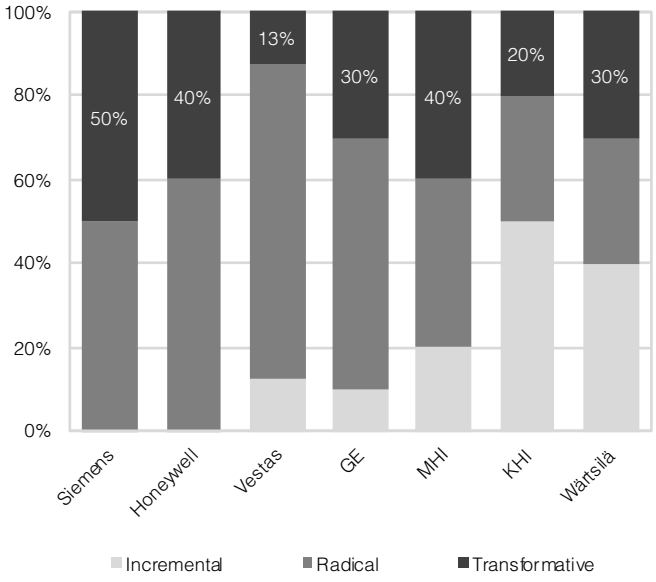
Source: CDP

Figure 46: Industrial Conglomerates - Low-carbon product scorecard

Company	Rank	Score	Top performing products
Siemens	1	81.2	Solutions for electrification, including storage (through various batteries technologies) Electromobility charging components (including sockets for freights and ships) Ultra HVDC Biomass and waste energy solutions, with investments also in hydrogen technology. IoT (Mindsphere) and digital platforms (e.g. CyPT-air) for connecting and optimizing industrial processes
Honeywell	2	75.2	Smart-grid control solutions to manage energy demand efficiently. Solutions for electrification, such as systems for electric aviation and electric compressors for fuel-cell vehicles. IoT operating systems such as Niagara for advanced connectivity. Biomass and green fuels.
Vestas	3	70.0	Hybrid renewable solutions and storage where it is expanding capabilities through partnerships with industry leaders and close collaboration with suppliers. Digital software solutions to optimize wind power and next gen turbine innovations.
Mitsubishi Heavy Industries	4	69.6	Clean energy technologies such as geothermal energy, waste conversion and hydro-power. Carbon Capture and Storage technologies. Efficiency drivers such as centrifugal pumps/heat recovery systems, energy digitalization platforms (Energy Cloud)
General Electric	5	68.0	Energy storage solutions (e.g. reservoir energy storage and solid oxide fuel cells) Digital solutions for traditional power and wind plants (Digital Power Plant and Digital Wind Farm) Leading technology in off-shore turbines (Heliade-X)
Kawasaki Heavy Industries	6	55.0	Hydrogen production technologies. Battery power for trains (Gigacell) Enhanced cold-storage functionality for LNG carriers (reducing boil-off gas) Efficiency/automation drivers (oil free centrifugal compressors, extra-large robots)
Wärtsilä	7	55.0	Hybrid marine systems Software platforms for micro-grids (GEMS) Engine solar-power plants.

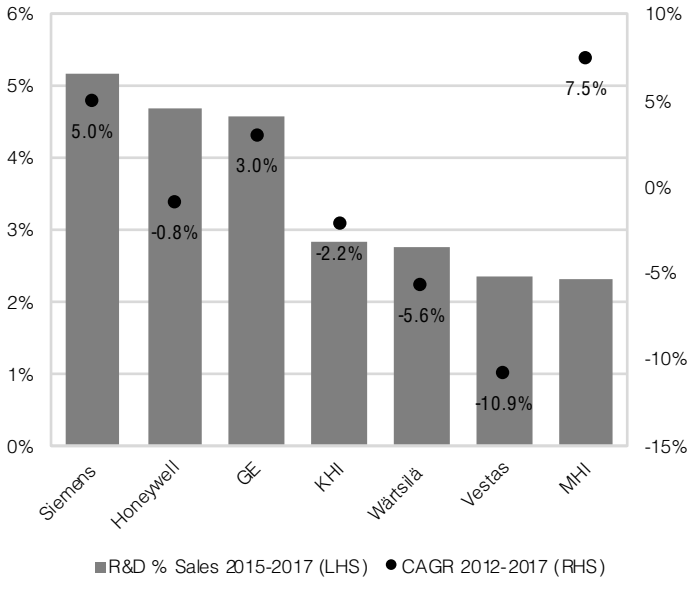
Source: CDP

Figure 47: Industrial Conglomerates - Low-carbon product technology split



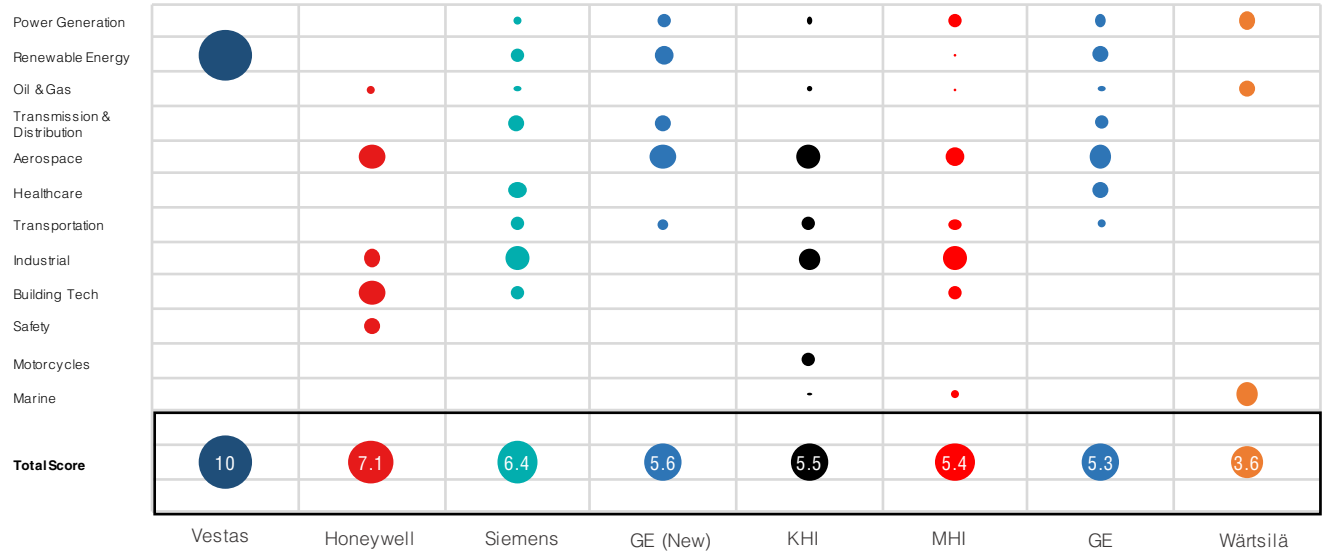
Source: CDP, Company reports

Figure 48: Industrial Conglomerates - R&D as % of sales



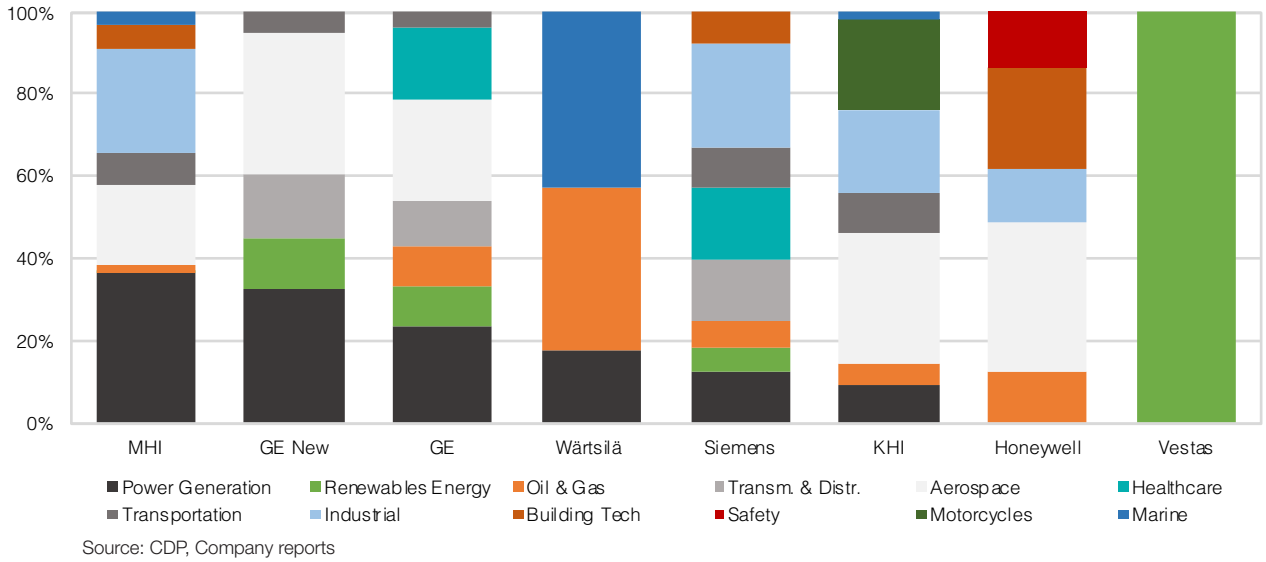
Source: CDP, Company reports

Figure 49: Industrial Conglomerates – Revenue split by division



Bubble size = revenue weighted market growth potential score - (score out of 10)
Source: CDP, Company reports

Figure 50: Industrial Conglomerates: End-market breakdown



Source: CDP, Company reports

Figure 51: Industrial Conglomerates - High Quality Patents per 10,000 employees (2000 - 2017)

Name	Clean Energy	Automation, Connectivity & Digitisation	Decentralized Energy	Efficiency	Electromobility	Weighted total (2000-2017)	Ranking
Vestas	617	45				331	1
MHI	149	117		76	42	96	2
KHI	57	91		25	8	45	3
Siemens(i)	54	45	19	5	6	26	4
Honeywell	13	42		18		24	5
Wärtsilä	5	7		9		7	6
General Electric	6	12	2	1		5	7

(i) Due to the high volume of patents for Siemens and limitations in the total number of patents that could be downloaded and analysed, we took the absolute number of Siemens patents for Clean Energy and Connectivity and divided through by the average employee numbers between 2000 – 2017. We then downloaded a sample of the data to calculate the average % of high quality patents and applied this factor to our calculation.

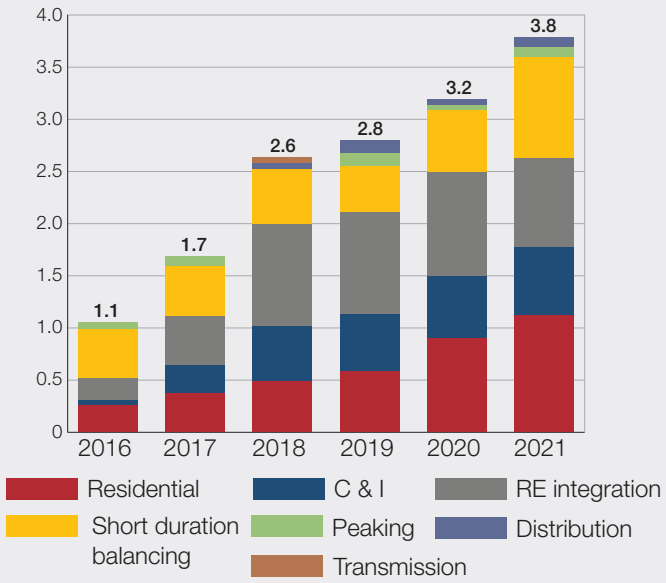
Source: Lens.org

Energy Storage and the Changing Face of Electricity Delivery

Energy storage in the form of electricity is now seen to be an integral part of today's energy supply chain. The need for energy storage for electricity has been driven in the past by matching supply to constantly changing demand and has been used for short-duration balancing.

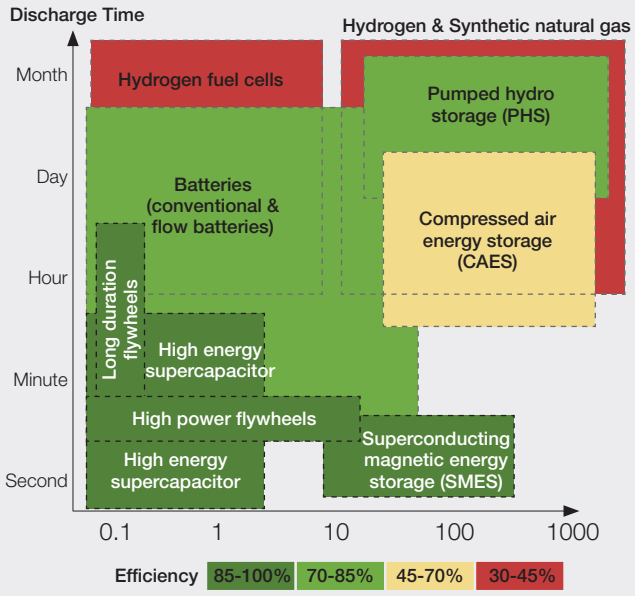
With the growth of renewable energy generation capacity both through centralized and decentralized supply, energy storage is now increasingly required to deal with the intermittent nature of renewable generation. In addition, energy storage has a role to play in providing more efficient capacity in transmission and distribution as an alternative to traditional network provision and demand management through behind the meter solutions at customer sites. The overall demand for energy storage is set to grow to 125 GW by 2030 from less than 10 GW at present and the type of demand for storage will see behind the meter solutions representing half of total installed capacity – this will lead to an investment opportunity of US$103bn spread across different geographies[9].

Figure 52: Global annual storage deployments by application (based on power output)



Source: Bloomberg New Energy Finance

Figure 53: Technology Matching to Time Frame for Energy Storage Required



Source: Energy storage technologies and real life applications – A state of the art review Aneke & Wang (2016)

Electricity in its form is not storable and therefore requires conversion into a form which is storable where it can then be converted it back to electricity when needed. There are different forms of storage that fall into five groups – mechanical, chemical, electro-chemical, superconducting magnetic and cryogenic (liquid) air energy storage. The stage of development, their functionality in terms of delivery of electricity – short or long duration, lifespan, energy density, efficiency and safety will all determine the deployment of the various technologies within these groups[10]. Aneke & Wang (2016) in their review of real life applications of energy storage technologies map out these uses in Figure 52.

Pumped Hydro Storage (PHS) is the main technology and accounts for 70% of current use mainly in the centralized grid services to shift electricity supply from times of low demand to times of high demand to reduce generation costs[11]. For batteries and other mechanical and thermal storage technologies, the economics of providing grid services while challenging today is expected to grow as costs fall and performance improves[11]. The use of batteries off grid either in conjunction with solar home systems or mini-grids is already being used either through subsidies as in the case of Germany where 40% of small-scale solar systems have battery systems or Australia where these are being installed without subsidies[11]

The demand for battery energy storage is also expected to be driven by behind the meter demand as both residential and commercial users use battery storage as a way to increase self-consumption or avoid peak demand charges.

Implications for exponential demand in energy storage

Critical to the deployment of electricity storage is the ability to derive revenues from a multiple range of services from one storage system[11]. Services will relate to frequency and quality of electricity as well as reserve capacity, integration of renewables and demand management.

This will have implications for planned generation capacity, transmission and distribution as well as other components of power electronics and services. Some areas are likely to be impacted more than others with 8% of total storage build in 2030 based on power output at the distribution level against 2% related to transmission level deployments according to BNEF forecasts[9].

9. Global Energy Storage Forecast – BNEF – Nov 15, 2017
10. Energy storage technologies and real life applications – A state of the art review – Mathew Aneke and Meihong Wang – June 2016
11. Electricity Storage and Renewables – Costs and Markets to 2030 – IRENA 2007

A closer look at wind turbines

Vestas, Siemens Gamesa (SG) and GE all benefit from a wide range of turbines suitable for different wind conditions, loads and performance requirements. Vestas dominates the 2.5-3.5MW market and competes head-to-head with SG in the more mainstream 2.0-2.5MW segment[12]. GE Renewables does best in the 1.5-2MW segment. From a technological perspective, the conventional high-speed geared system continues to be the main technology although its market share has dropped in 2017 to 68.8% from 73.9% of the year before. Vestas was the top supplier of conventional wind turbines in 2017, followed by SG and GE Renewables. The market for direct drive turbines increased from 25.4% to 28.4% in 2017 primarily driven by SG. The market share of hybrid drive turbines increased in 2017 primarily due to Vestas' off-shore turbines.

Figure 54: Market share by size range

	Vestas	SG	GE Renew	MVOW	Where:
1500-1999 kW	7.7%		13.0%		#1
2000-2500 kW	11.1%	12.2%	7.1%		#2
2501-3599 kW	33.0%	16.9%	10.7%		#3
3600-5000 kW		37.2%			#4
> 5000 kW		61.6%		22.3%	#5

Source: FTI Intelligence

Figure 55: Market share by technology

Turbine Technology	Conventional drive	Hybrid drive	Direct drive EESG* DD	Direct drive PMG** DD
1	Vestas	MVOW	Enercon	Goldwind
2	SG	SG	China Energine	SG
3	GE Renew	Mingyang	Wind World	XEMC
4	Envision	Zhongren	EWT	Dongfang
5	Nordex	Unison		Regen PT

* Electrically excited synchronous generator; ** Permanent magnet generator
Source: FTI Intelligence

The average size of turbines installed continues to increase, with the average rated capacity of new installed turbines in 2017 at 2,400 kW, or 11% above 2016 level. The UK became the first country in 2017 where average size of new installed turbines has passed the 3,500 kW mark. Rotor size is also increasing, typically at a steeper rate than rated capacity, as larger swept areas and lower specific ratings (the turbine rated capacity divided by the swept area) can capture more energy at low wind speeds[13]. In the US, the average rotor diameter more than doubled from 47.8m in 1998-99 to 102m in 2015, leading to a drop in specific power rating of installed turbines from 394 w/m2 to 246 w/m2[14]. In off-shore the trend has been to build taller towers (wind tend to be more stable at greater heights), with bigger rotors, higher capacity and larger capacity factors, making the turbine less sensitive to wind speed variations, improving predictability and AEP rates, and ultimately increasing the return on investment.

In the table below, we show some key data on capacity and size of on and off-shore turbines. Vestas and SG benefit from the widest wind range covered on-shore, including turbines for IA turbine classes (10m/s wind and higher turbulence category) for high winds and typhoons. GE on the other hand benefits from the on-shore turbine with the highest nominal capacity and rotor diameter in low/medium winds (4.8-158), allowing for the onshore industry's highest annual energy production Annual Energy Performance (AEP) according to GE, and ready for commercial deployment by the end of 2019.

In off-shore, MHI Vestas Off-shore Wind (MVOW) currently produces the most powerful wind turbine at 9.5MW and 164m rotor diameter, with SG not far with a 8-9MW turbine and 167m diameter, although these will be outperformed by GE newly announced Haliade-X, a 12MW turbine with 220m rotor that will be available for demonstration in 2019, with the first units shipped in 2021.

Figure 56: Technical review of main wind turbines

	On-shore			Off-shore	
	Wind covered	Max nominal power	Max diameter	Max nominal power	Max diameter
SG	IA-IIIA	4.3	148	8	167
GE	II-IIIB	4.8	158	12	220
VST/MVOW	IA-IIIB	4.2	150	9.5	164

Source: CDP

Fig 57. Nominal capacity (X) and rotor diameter (Y) for SG, GE, VST/MVOW on/off-shore turbines

Source: CDP

12. FTI Intelligence, 2018
13. IEA 2016, Next generation wind and solar power
14. Wiser and Bolinger, 2016

Heavy Machinery

- Themes running through the machinery group include electrification of Heavy Machinery and heavy-duty vehicles, circularity through the provision of remanufacturing services and advanced autonomy.
- Autonomy was distinguished from automation and only products that used autonomy to deliver significant energy or fuel efficiency gains were considered to be 'low-carbon' with labor productivity implications not being considered.
- CNHI leads the Heavy Machinery group with the largest portfolio of low-carbon products. CNHI provide electric heavy duty vehicles and re-manufacturing services. They are also piloting methane powered tractors and are involved in truck platooning initiatives.
- PACCAR rank last in the Heavy Machinery group with 56% of its low-carbon products deriving from incremental innovations associated with basic automation.
- Hitachi was ranked in first position for the total number of patents filed (per 10,000 employees) with 56% focusing on technologies that relate to the electrification of construction and mining machinery. Hino Motors is in second with a large number of patents filed for technologies that promote fuel efficiency. Kubota and Komatsu follow behind in third and fourth position respectively.
- On R&D, Deere scores best with 4.9% R&D intensity, followed by Komatsu (3.9%) and Hino (3.6%). At the other end are PACCAR (1.4%) and Hitachi (2.5%).

Figure 58: Heavy Machinery - Transition opportunities summary

Company	Low-carbon Product Scorecard	R&D % Sales	Patent Analysis	Overall weighted rank	Rank
Kubota	2	5	3	2.0	1
Hitachi Construction	3	6	1	2.1	2
CNH Industrial	1	4	6	2.2	3
Deere & Company	4	1	5	3.3	4
Hino Motors	5	2	2	4.2	5
Komatsu	6	3	4	5.9	6
PACCAR	7	7	7	7.0	7
Weighting	**70%**	**15%**	**15%**		

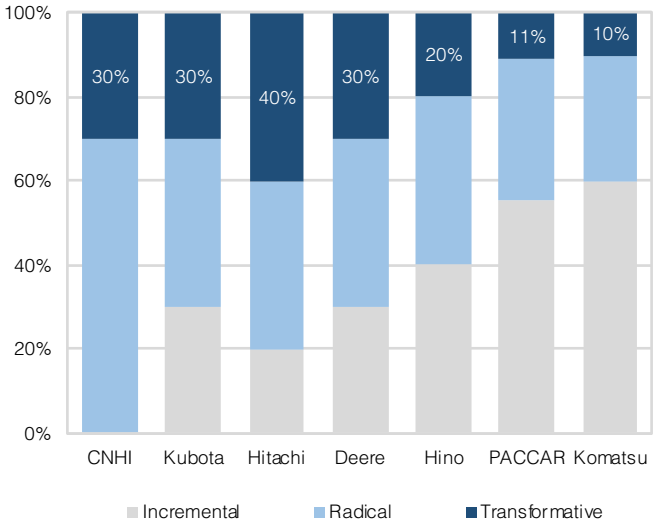
Source: CDP

Figure 59: Heavy Machinery - Low carbon product scorecard

Company	Rank	Score	Top performing products
CNH Industrial	1	59.2	Remanufacturing services for used machinery encouraging circularity Electric machinery/heavy duty vehicles Biofuel based machinery and methane powered tractors (pilot phase) Autonomous vehicles and truck platooning initiatives.
Kubota	2	58.0	Electric battery powered farm machinery Highly efficient air conditioning technologies Autonomous machinery Smart IoT infrastructure for optimizing agricultural operations
Hitachi Construction	3	56.0	Electric construction and mining machinery Internet enabled vehicle management systems Machines for the on-site recycling of materials encouraging circularity
Deere & Company	4	50.0	Deere has the most diversified and largest portfolio of low-carbon products Remanufacturing services for used machines and platforms for purchasing used machinery. Electric utility vehicles Smart/precision agriculture offerings which enable connectivity between distributed farm machinery
Hino	5	44.0	Hino has a limited portfolio of low-carbon products Hybrid and full electric vehicles Fuel efficient vehicles with digital fuel management capabilities.
Komatsu	6	37.2	Electric drive trucks Semi-automated machinery and smart IoT infrastructure for optimizing construction and mining operations
PACCAR	7	36.8	Battery electric trucks Diagnostic software that maximizes operational performance The Truck Locator which pairs customers with refurbished used trucks rather than new trucks

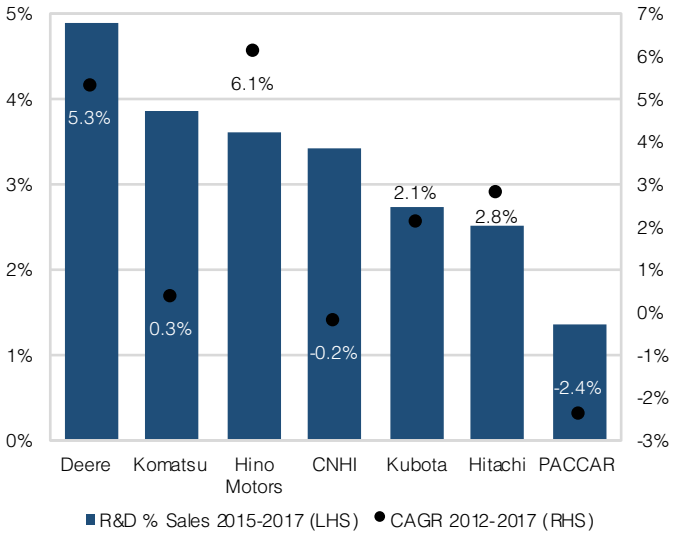
Source: CDP

Figure 60: Heavy Machinery - Low-carbon product technology split



Source: CDP, Company reports

Figure 61: R&D as % of sales



Source: CDP, Company reports

Figure 62: Heavy Machinery - High Quality Patents per 10,000 employees (2000 - 2017)

Company	Electrification	Fuel and Connectivity	Weighted total (2000-2017)	Ranking
Hitachi Construction	184	144	164	1
Hino Motors	112	172	142	2
Kubota	159	108	133	3
Komatsu	148	86	117	4
Deere & Co	68	45	56	5
CNH Industrial	23	19	21	6
PACCAR	9	14	12	7

Source: Lens.org

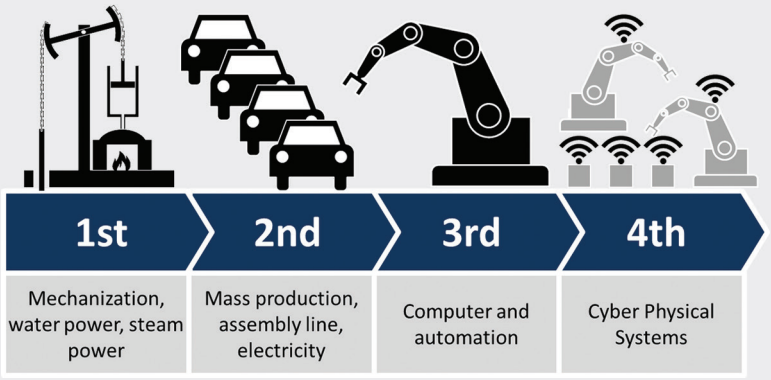
The Fourth Industrial Revolution

Disruptive technologies and digital innovations are bringing a new wave of technological advancement which will see fully connected and automated manufacturing systems.

Branded as 'Industry 4.0', the transformation to a 'smart factory' presents opportunities for optimizing productivity and efficiency across the value chain.

Historically, significant advances in industrial production have occurred across three major eras (see Figure 63) thanks to the steam engine in the 1800s, mass production powered by electricity in the early 1900s, and computers enabling automation in the 1970s.
Today a fourth industrial revolution is being powered by the technological advances shown in Figure 64:

Figure 63: Industrial revolutions



Source: www.allaboutlean.com

Figure 64: Technologies transforming industrial production

Source: i-SCOOP

These advancing technologies will transform industrial production. Today, automated processes use rules-based systems to address a fixed set of scenarios. Future technical systems will use artificial intelligence (AI), allowing for smart decisions and flexibility in unexpected situations.

Manufacturers will be able to use virtual models to simulate plant operations, leveraging real-time data to test and optimize machine settings in a virtual world before implementing any real-world changes. This will reduce set-up times, reduce the number of prototypes needed and improve overall quality.

Companies offering industrial equipment and automation technology will play a major role in the digitalization of production, and are presented with a huge opportunity to meet the growing demand for AI-supported systems in factories. Companies can develop new business models such as "machinery as a service" and offer equipment that uses machine-learning techniques to analyze variables and self-optimize.

With increased connectivity across the entire value chain enhanced cybersecurity will be essential. A BCG survey[15] found that more than 40% of automotive production managers see data security as a major challenge and about 30% had concerns over the uncertainty of data ownership. Machinery and automation producers can offer multi-level security measures to protect critical industrial systems and intellectual property.

15. The Factory of the Future, the Boston Consulting Group (BCG)

Climate governance & strategy

Overview

Incorporating climate-related factors into business decision-making provides insight into how companies are positioning themselves for the transition to a low-carbon economy. As end-markets transform, companies with the appropriate governance will be better placed to identify risks and opportunities early and adjust their corporate strategy accordingly.

The presence of climate experts on the board and an active management of Scope 3 emissions intensity in particular would enable companies to maximize their opportunity set. The Autos sector provides a good template of how early movers were able to anticipate significant changes in regulatory landscape and consumer preferences. Within the Capital Goods sector, an example of where companies' strategies are being tested is by changing demand patterns in the power sector.

A few companies have started to set Scope 3 emission reduction targets and have climate expertise at the board level. However, more needs to be done with regard to Scope 3 emissions measurement and management. Current emissions reduction targets and remuneration are linked mainly to Scope 1 and 2 which are not aligned with long term decarbonization opportunities for the sector.

In this section, we assess physical risk exposure by looking at how well companies are engaged with suppliers where we see risks emerging and whether they conduct Life Cycle Analysis (LCA).

We evaluate companies in this section based on the following metrics:

Metric 1) Emission Reduction Targets (25%): We assess the coverage and strength of companies' emissions reduction targets with a focus on Scope 3 emissions.

Metric 2) Supplier Engagement and life cycle analysis (25%): We assess companies based on the degree to which they engage with suppliers by looking at the % of suppliers engaged as a % of total spend and also the extent to which companies are using life-cycle analysis (LCA).

Metric 3) Board level climate management (20%): Companies are assessed on a number of factors relating to board and executive climate responsibility performance including the level of directors on the board with climate related experience, the presence of climate-related committees (at board and/or executive levels) and the overall quality of climate-risk management systems.

Metric 4) CDP Score (15%): The 2017 CDP Score provides an aggregate measure of the quality of climate-related disclosure and management systems addressing climate risks.

Metric 5) Climate-related remuneration (10%): We assess the alignment between climate-risk management and remuneration across short-term annual bonus schemes and long-term incentive programs at the senior executive and board level as well as other climate-risk remuneration practices at broader corporate levels.

Metric 6) Use of internal carbon price (5%): This metric is used to identify the extent to which internal carbon prices are incorporated into future capital expenditure plans and other key business decisions.

Overall highlights

- Only seven out of 22 companies have set Scope 3 emission reduction targets based on Use of Sold Products. This is mainly by the Heavy Machinery sub-sector, followed by the Industrial Conglomerates.
- Mitsubishi Electric is the only Electrical Equipment company with a Scope 3 emissions reduction target covering its main portfolio of end products.
- Siemens has the strongest Scope 1 + 2 target, with a net-zero emissions target by 2030.
- Vestas and Honeywell have the most robust board level climate management, with the most climate experienced board of directors and frequent monitoring of climate risks.
- Emerson ranks bottom with limited climate expertise at board level and weak board / executive climate governance, followed by GE and Rockwell.
- Schneider are the only Capital Goods company to financially incentivize climate-risk management in long-term bonus schemes. Apart from Eaton and Schneider none of the companies disclose any form of short-term climate-related remuneration targets.
- Schneider is also the only company to disclose an internal carbon price which they use to inform decisions on energy supply.

Figure 65: Electrical Equipment - Climate governance and strategy rank

Company	Emission reduction targets	Supplier Engagement and life-cycle analysis	Board level climate management	CDP score	Climate related remuneration	Internal carbon price	Overall weighted rank	Climate governance & strategy rank
Schneider Electric	3	4	1	A	1	1	2.16	1
Mitsubishi Electric	1	2	6	A	4	2	2.56	2
Johnson Controls International	2	2	3	A-	3	3	2.77	3
Eaton	7	1	5	A-	2	3	3.70	4
ABB	4	5	3	C	4	3	4.48	5
Nidec	6	6	2	Not scored	4	3	5.36	6
Rockwell Automation	5	6	7	D	4	3	5.57	7
Emerson Electric	8	6	8	D	4	3	7.26	8
Weighting	**25%**	**25%**	**20%**	**15%**	**10%**	**5%**		

Source: CDP

Figure 66: Industrial Conglomerates - Climate governance and strategy rank

Company	Emission reduction targets	Supplier Engagement and life-cycle analysis	Board level climate management	CDP score	Climate related remuneration	Internal carbon price	Overall weighted rank	Climate governance & strategy rank
Vestas	2	1	1	C	3	3	2.51	1
Siemens	3	2	3	A-	2	3	3.05	2
Honeywell	5	5	2	B	3	1	3.63	3
Wärtsilä Corporation	1	5	5	B	3	2	3.97	4
Kawasaki Heavy Industries	6	3	6	B	3	3	4.64	5
Mitsubishi	7	4	4	B	3	3	5.24	6
General Electric	4	7	7	C	1	3	5.46	7
Weighting	**25%**	**25%**	**20%**	**15%**	**10%**	**5%**		

Source: CDP

Figure 67: Heavy Machinery - Climate governance and strategy rank

Company	Emission reduction targets	Supplier Engagement and life-cycle analysis	Board level climate management	CDP score	Climate related remuneration	Internal carbon price	Overall weighted rank	Climate governance & strategy rank
Komatsu	1	2	2	A	4	2	2.45	1
CNHI	5	3	5	A-	1	1	3.47	2
Deere & Company	7	1	1	C	2	2	3.68	3
Hino Motors	2	6	2	B	4	2	3.70	4
Kubota	6	4	2	A-	4	2	4.35	5
Hitachi Construction	3	7	5	A-	4	2	4.38	6
PACCAR	4	5	7	A-	2	2	4.49	7
Weighting	**25%**	**25%**	**20%**	**15%**	**10%**	**5%**		

Source: CDP

Emission reduction targets

- Most companies have some level of target setting, with only one company having set no targets at all (Emerson) and two companies having recently expired targets (Eaton and MHI), although Eaton has committed to a SBTI.
- We consider Scope 3 targets (Purchased goods and Use of Sold Products) as the most relevant for this sector, given the relative weight of Scope 3 vs Scope 1 + 2 emissions. Out of the 22 companies only seven have set Scope 3 targets (Mitsubishi Electric, Wärtsilä, Vestas, Komatsu, Hitachi Construction, PACCAR, Hino).
- The level of ambition of Scope 1 & 2 is similar across the three sub-sectors, with a decrease of 2% a year implied by companies' targets. Siemens stands out with a net zero emission target by 2030.
- Only one company (Komatsu) has had its target approved by the Science Based Targets Initiative (SBTI). Schneider, Eaton, Hitachi Construction and CNHI have committed to a SBTI.

Electrical Equipment

- Emerson and Eaton have not set an emissions reduction target.
- Mitsubishi Electric is the only company in the sub-group to set a Scope 3 target (Use of Sold Products). This is not for the entire product suite (107 products only) but it signals focus on the key emitting phase of the value chain. They rank first on the metric.
- JCI ranks second with the second highest level of ambition (-2.7% p.a.). Schneider is a close third and is the only company in the sub-group to set a long-term target (2050) in addition to intermediate ones.
- The level of ambition of the sub-group's targets range from -1% of implied reduction (Nidec) to -3% (ABB).

Figure 68: Electric Equipment - Emission reduction targets

Company	SBTi Commited / Approved	Scope	Absoulte / Intensity Target	Target period	% reduction from base year	Target CAGR
Mitsubishi Electric[i]	✓	Scope 3: Use of Sold Products[ii]	Absolute	2001–2021	35%	-2.1%
Johnson Controls International	✗	Scope 1 + 2	Intensity	2014–2020	15%	-2.7%
Schneider Electric[iii]	✓	Scope 1 + 2	Absolute	2015–2050	53%	-2.1%
ABB	✗	Scope 2	Intensity	2013–2020	20%	-3.1%
Rockwell Automation	✗	Scope 1 + 2	Intensity	2008–2022	25%	-2.0%
Nidec	✗	Scope 1 + 2	Intensity	2015–2018	3%	-1.0%
Eaton	✓	Target expired				
Emerson Electric	✗	No target				

(i) Mitsubishi also have a Scope 1 + 2 target that is the most aggressive amongst the companies
(ii) Mitsubishi's Scope 3 target relates to 107 products
(iii) Schneider Electric also gave a Scope 3 target that focuses on Downstream Transportation and Distribution
Note: Companies were assessed on their best target only
Source: CDP

Industrial Conglomerates

- MHI is the only company in the sub-group not to have set a current emissions reduction target.
- Only Wärtsilä and Vestas set Scope 3 (Use of Sold Products) targets.
- Siemens stands out with a net zero commitment on 100% of Scope 1 + 2 emissions by 2030 and intermediate targets to set the path. However, it doesn't rank in first position due to the absence of a Scope 3 target.
- GE and Honeywell rank middle of the pack, with absolute targets set for 100% of Scope 1+2 emission, but the reference year is not distant and the level of ambition average (2%). KHI scores toward the bottom, with the lowest level of ambition and only partial coverage of Scope 1 + 2 emissions as part of their target.

Figure 69: Industrial Conglomerates - Emission reduction targets

Company	SBTi Commited / Approved	Scope	Absoulte / Intensity Target	Target period	% reduction from base year	Target CAGR
Wärtsilä	✗	Scope 3	Intensity	2015–2020	15%	-3.2%
Vestas	✗	Scope 1 + 2 + 3	Intensity	2015–2020	5%	-1.0%
Siemens	✗	Scope 1 + 2	Absolute	2014–2050	100%	Net Zero
General Electric	✗	Scope 1 + 2	Absolute	2011–2020	20%	-2.4%
Honeywell	✗	Scope 1 + 2	Intensity	2013–2018	10%	-2.1%
Kawasaki Heavy Industries	✗	Scope 1 + 2	Absolute	2014–2031	7%	-0.4%
Mitsubishi Heavy Industries	✗	Target expired				

Note: Companies were assessed on their best target only
Source: CDP

Heavy Machinery

- Komatsu, Hino Motors and Hitachi Construction rank first, second and third respectively as they are the only companies to have set a Scope 3 target (Use of sold product). In particular, Komatsu's target covers all Scope 3 categories and 100% of Scope 3 emissions.
- None of the companies have a long-term target, with 2030 being the most distant target year (Komatsu, Hitachi Construction, Kubota).
- On level of ambition of the targets, Hino Motors scores best, with -6% p.a. implied CAGR, followed by Komatsu. Hitachi Construction has the lowest implied level (-0.7%).
- Komatsu is the only company to have had their target approved by the SBTi. Hitachi claims that their target is science-based but this has not yet been approved.

Figure 70: Heavy Machinery - Emission reduction targets

Company	SBTi Commited / Approved	Scope	Absoulte / Intensity Target	Target period	% reduction from base year	Target CAGR
Komatsu[i]	✓	Scope 3: All Categories	Absolute	2012–2030	46%	-3.4%
Hino Motors	✗	Scope 3: Use of Sold Products	Absolue	2013–2050	90%	-6.0%
Hitachi Construction[i]	✓	Scope 3: Use of Sold Products	Absolute	2005–2025	13%	-0.7%
PACCAR[i]	✗	Scope 3: Use of Sold Products	Intensity	2010–2018	6%	-0.8%
CNH Industrial	✓	Scope 1 + 2	Absolute	2014–2022	17%	-2.3%
Kubota	✗	Scope 1 + 2	Absolute	2014–2030	30%	-2.2%
Deere & Company	✗	Scope 1 + 2	Intensity	2012–2018	15%	-2.7%

(i) Komatsu, Hitachi Construction and PACCAR also have Scope 1 + 2 targets. Companies were assessed on their best target only
Source: CDP

Supplier Engagement and Life-Cycle Analysis

- The Heavy Machinery sub-sector is much more engaged than the other two sub-sectors with their suppliers.
- Eaton and Deere are engaged with a 100% of their suppliers based on total spend.
- A number of companies across the sub-sectors undertake some form of life cycle analysis (LCA) with better performance on LCA for the Heavy Machinery sector given their narrower product portfolio.

Electrical Equipment

- The top four performers have engaged with their suppliers at a relatively high level ranging from 62% to 100% whereas the bottom four have no disclosed supplier engagement.
- Eaton, Mitsubishi Electric, Schneider and JCI engage with their suppliers whereas ABB, Emerson, Nidec and Rockwell do not.
- The same companies that have supplier engagement programmes also undertake LCA with ABB the only one with no supplier engagement but has a limited LCA programme.

Industrial Conglomerates

- The Industrial Conglomerates have a much lower range of engagement with their suppliers at 1% – 45%.
- Of the three companies with supplier engagement Vestas, KHR and Siemens – the latter only covers 1% of revenues as a result of engagement with their aluminium suppliers.[16]
- Mitsubishi Heavy, Wärtsilä, Honeywell and GE have no disclosed supplier engagement programmes.
- Most companies have some form of LCA with only two companies Siemens and Vestas with good LCA.

Heavy Machinery

- Much better supplier engagement across this group with most companies engaging at over 40% except Hino Motors at 11%.
- This group also shows better performance on LCA with 5 companies in this group – Deere, PACCAR, CNH, Komatsu and Kubota with good LCA programmes.

Figure 71: Electrical Equipment - Supplier engagement and LCA

Company	Suppliers engaged as % of total spend	LCA
Eaton	100%	Good
Mitsubishi Electric	80%	Good
JCI	80%	Good
Schneider Electric	62%	Good
ABB	0%	Moderate
Emerson	0%	None
Nidec	0%	None
Rockwell	0%	None

Source: CDP

Figure 72: Industrial Conglomerates - Supplier engagement and LCA

Company	Suppliers engaged as % of total spend	LCA
Vestas	45%	Good
KHI	15%	Good
Siemens	1%	Moderate
MHI	0%	Moderate
Wärtsilä	0%	Limited
Honeywell	0%	Limited
General Electric	0%	Limited

Source: CDP

Figure 73: Heavy Machinery- Supplier engagement and LCA

Company	Suppliers engaged as % of total spend	LCA
Deere & Company	100%	Good
PACCAR	83%	Good
Komatsu	63%	Good
CNHI	56%	Good
Kubota	47%	Limited
Hitachi Construction	40%	Good
Hino Motors	11%	Limited

Source: CDP

16. Note: Siemens 1% is as reported by the company on the CDP questionnaire. This is likely to be a conservative interpretation, as Siemens also reports that they work closely and extensively with their suppliers, and all suppliers have to follow their principles of sustainability

Board level climate management

- Vestas demonstrate the most robust climate management at board level, with by far the most climate experienced board of directors, both a board level and executive level climate committee and bi-annual monitoring of climate risks across all operating regions.

- Honeywell also perform strongly on this metric, with both board and executive climate committees with climate risks assessed across all operating regions.

- The worst performing company is Emerson Electric by a significant margin. They do not have any board members with climate expertise, nor do they have either a climate committee at the board or executive level and their climate risks are only monitored sporadically, with an unknown climate-risk time horizon.

Electrical Equipment

- Schneider Electric perform the best of the Electrical Equipment companies with three board members with varying levels of climate expertise (including a Commissioner for the Global Commission on the Economy and Climate), an executive sustainability committee which oversees climate issues and they also provide detailed disclosure of their climate risk management framework at both the macro and micro levels.

- The worst performing company by a distance is Emerson Electric. They do not have any board members with climate expertise, nor do they have either a climate committee at the board or executive level and their climate risks are only monitored sporadically, with an unknown climate-risk time horizon.

Industrial Conglomerates

- A strong performance from the Industrial Conglomerates sees Vestas come first and Honeywell come second, both for Industrial Conglomerates and overall across the capital good companies.

- Vestas have the most climate competent board of directors including a former UN climate advisor and former Minister of State for Climate and Energy. Moreover, they also have both board and executive climate committees.

- Honeywell also have both board level and executive level climate committees and a strong climate risk management framework, assessing company-wide and asset specific climate risks on a regular basis.

Heavy Machinery

- Deere & Company come top of the machinery companies with two board members with varying levels of climate competency, both a board and executive level climate committee and a robust climate management framework.

Figure 74: Electrical Equipment - Board level climate management

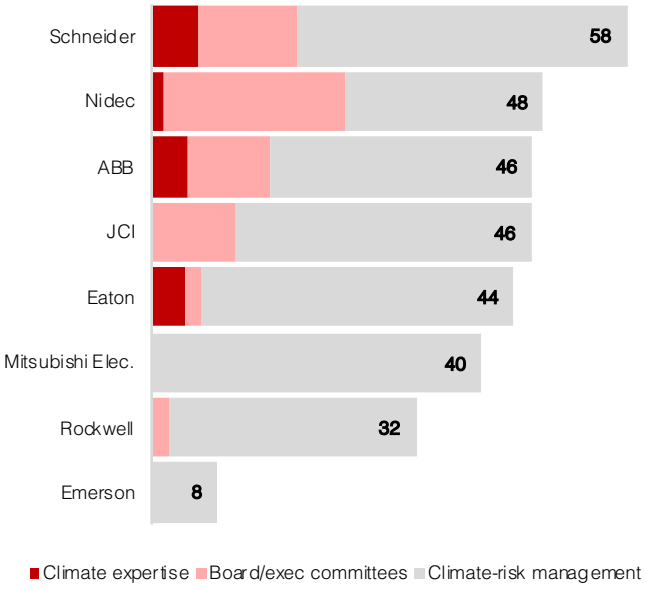


Figure 75: Industrial Conglomerates - Board level climate management

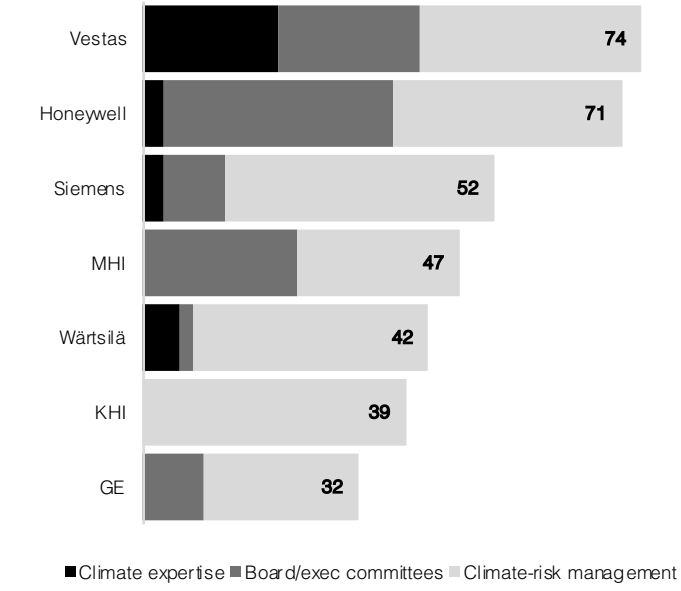
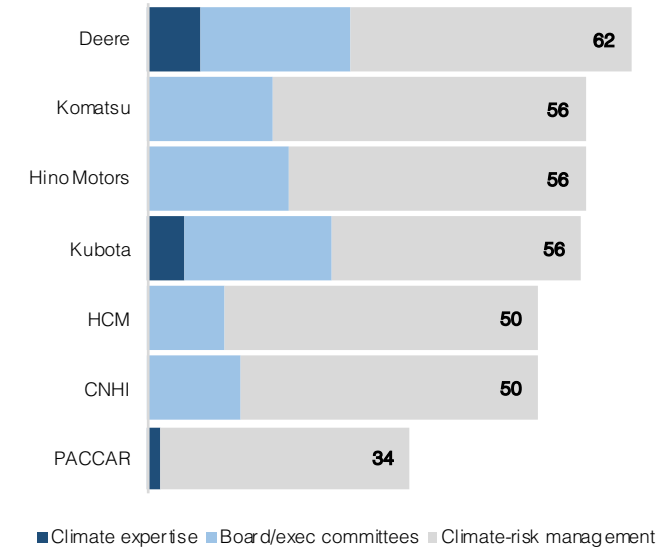


Figure 76: Heavy Machinery - Board level climate management

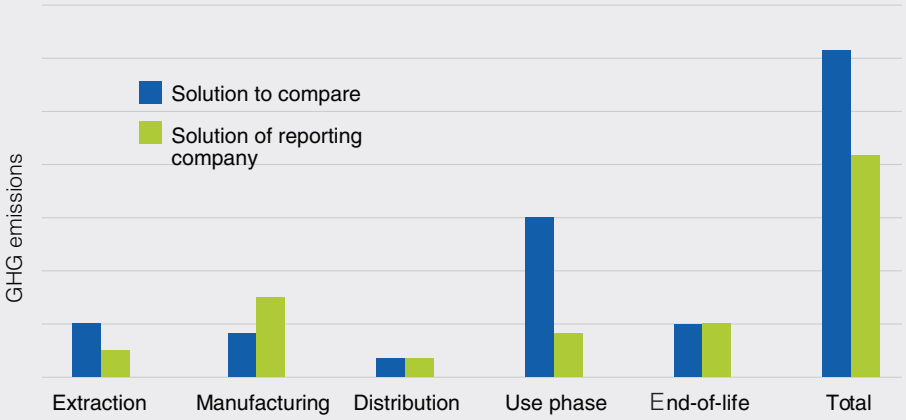


Avoided emissions in the Capital Goods sector

Companies can develop products and services that avoid emissions, either by enabling emission reductions or by providing a low-emission version of existing products. Although, certain companies already quantify, report and set targets around avoided emissions, there is no international standard or consistent terminology to describe avoided emissions which leads to inconsistent measuring and reporting[17].

Generally, avoided emissions are the cumulative emission savings that occur as a result of the use of a product, compared to a baseline solution, along the value chain. Avoided emissions are generally quantified along the value chain as aggregated emission savings considering all life cycle stages (including production) and also including indirectly caused emission decreases outside the organization's own operations (e.g. in the use stage)[18].

Figure 77: Avoided emissions from cradle to grave



Source: TBD

However, such is the inconsistency regarding the definition of avoided emissions, Siemens note in their CDP response that the CO_2 emissions from the manufacture of their individual products are part of their carbon footprint and are not included in the emission calculations of their avoided emissions products and services portfolio; avoided emissions for Siemens only occur in the 'use phase' or 'Use of Sold Products' Scope 3 category.

The inconsistency in measuring avoided emissions is such that only the Chemicals and ICT sectors have published guidelines.

Cross-sector guidelines do not currently exist, nor do guidelines for the Capital Goods sector. Despite that, Capital Goods companies still report on avoided emissions:

Electrical Equipment

Numerous Electrical Equipment companies focus on creating more energy efficient electric motors. Examples include:

- Eaton Corp focus on increased fuel economy through driving where onboard refueling vapor recovery (ORVR) systems reduce hydrocarbon emissions by about 95 percent during refueling.
- JCI helped customers save 1.7 million metric tons CO_2e through lithium-ion solutions for micro hybrid applications and start-stop technologies.
- Schneider Electric focus on reducing their Scope 3 emissions through proper transport mode selection, selection of carriers with fuel efficient vehicles and optimized supply chain design. Moreover, Schneider Electric have taken the external commitment to quantify CO_2 impacts and gains for customers (by end 2017) for 100% of their main projects.

Industrial Conglomerates

The Industrial Conglomerates have a broad focus on improving efficiency and creating low-carbon products, ranging from LED lighting and more efficient air conditioning to turbochargers to improve fuel efficiency. Other good examples include:

- The Siemens Environmental Portfolio consists of products, systems, solutions and services focusing on energy efficiency and renewable energy, with strict selection criteria for each including at least a 20% improvement in energy efficiency during the customer use phase compared to the applicable baseline e.g. combined cycle power plants. With the Siemens EP elements installed in FY16, Siemens helped their customers reduce their emissions by 521 mmt.
- For Kawasaki, In fiscal 2017, the CO_2 emission reduction effect through product-based contributions amounted to 898,000 tons, up 20% year on year, thanks to an increase in the number of high-efficiency power generation systems and biomass boilers, high-propulsion performance ships, and other systems delivered

Heavy Machinery

The different machinery companies attempt to avoid emissions through the use of their more efficient sold products in the fields of agriculture, transportation, chemical engineering and construction to name but a few end sectors. Good examples include:

- Kubota introducing cracking coils into ethylene cracking furnaces to improve thermal transfer efficiency, achieving a 50% reduction of fuel consumption during decoking compared to previous models.
- Komatsu talk of how the production and assembling of construction equipment (namely hydraulic excavators) emit only 10% of the total life cycle emissions, with 90% of emissions from fuel consumption when they are used. Accordingly, they have focused on developing hybrid and other highly fuel-efficient machines.

17. GHG Protocol: https://ghgprotocol.org/standards/avoided-emissions
18. LafargeHolcim: https://www.lafargeholcim.com/sites/lafargeholcim.com/files/atoms/files/lafargeholcim-avoided-emissions-protocol.pdf

CDP Score

- Mitsubishi Electric, Schneider Electric and Komatsu are 3 of only 120 companies to make the CDP's 2017 A-list for corporate disclosure.
- There is generally good disclosure across the subsectors with excellent disclosure from the Heavy Machinery companies, 5 out of seven companies scoring an 'A-' or higher.
- Rockwell Automation, Emerson and Nidec are among the companies with the poorest disclosure scoring 'D' or lower.

Electrical Equipment

- Mitsubishi Electric and Schneider Electric make the CDP A-List with Eaton and Johnson Controls Int. also performing well with a CDP score of 'A-'.

Figure 78: Electrical Equipment - CDP score

Company	2017 Score
Mitsubishi Electric	A
Schneider Electric	A
Eaton Corp	A-
Johnson Controls Intl.	A-
ABB	C
Rockwell Automation	D
Emerson Electric	D
Nidec Corp	Not scored

Source: CDP

Industrial Conglomerates

- Siemens come top with an 'A-' CDP score. KHI, Honeywell, MHI and Wärtsilä score a 'B' with General Electric and Vestas scoring a 'C'.

Figure 79: Industrial Conglomerates - CDP score

Company	2017 Score
Siemens	A-
Kawasaki Heavy Industries	B
Honeywell	B
Mitsubishi Heavy Industries	B
Wärtsilä	B
General Electric	C
Vestas	C

Source: CDP

Heavy Machinery

- Komatsu have the highest CDP score with an 'A' with PACAAR, CNHI, Hitachi and Kubota scoring an 'A-'. Hino Motors and Deere score a 'B' and 'C' respectively.

Figure 80: Heavy Machinery - CDP score

Company	2017 Score
Komatsu	A
PACCAR	A-
CNH	A-
Hitachi Construction	A-
Kubota	A-
Hino Motors	B
Deere & Company	C

Source: CDP

Climate-related remuneration

- Schneider Electric are the only Capital Goods company to financially incentivize climate-risk management in long-term bonus schemes, where executives have 10% of their Long-Term Incentive Plan (LTIP) linked to energy and emissions targets.
- Only Eaton and Schneider Electric have any form of short-term climate-related remuneration targets where Eaton link reducing emissions to executive pay and Schneider link eco-products and CO_2 avoidance to their executives' annual bonus scheme.

Electrical Equipment

- Generally, not a great range of scores for the Electrical Equipment companies, with only three of the eight disclosing any form of climate-related remuneration.
- Schneider Electric score the best any company has ever scored for climate-related remuneration using the methodology introduced in the 2017 Chemicals report.
- 10% of executive short-term bonuses focus on 16 'planet & society' targets, of which half are focused on the climate e.g. 10% energy savings and 10% CO_2 savings from transportation 2015-17.
- For the long-term bonus scheme at Schneider Electric, 20% is geared around 'planet & society' targets and with half of these targets having a climate focus this means 10% of executive long-term pay is based on performance on climate-related metrics.

Figure 81: Electrical Equipment - Climate related remuneration

Company	Short Term Incentive	Long Term Incentive	Sub-executive remuneration	Description	Score	Rank
Schneider Electric	✓	✓	✓	10% of executives' annual bonus and 20% of executive LTIPs are linked to 'planet & society' which comprises of 16 targets, eight of which are climate-focused. At a sub-exec level, these targets are also linked to variable pay across the company.	90	1
Eaton Corporation	✓	✗	✗	For executives, annual bonus is comprised of EPS (50%) & Cash flow (50%) but this is mulitplied by individual performance factors including emission reduction targets.	24	2
Johnson Controls International PLC	✗	✗	✓	Plant managers have a monetary incentive to achieve goals including energy reduction targets.	8	3

Note: ABB, Emerson, Mitsubishi Electric, Nidec and Rockwell Automation do not appear to have any climate related remuneration policies.
Source: CDP

Industrial Conglomerates

- Only two of the seven Industrial Conglomerates display any form of climate-related remuneration with none of them incentivizing executives short-term or long-term bonuses with climate-related targets. All their climate-related remuneration targets are at sub-executive level

Figure 82: Industrial Conglomerates - Climate related remuneration

Company	Short Term Incentive	Long Term Incentive	Sub-executive remuneration	Description	Score	Rank
Honeywell International Inc.	✗	✗	✓	Energy Managers from each business group have annual performance goals related to achieving their GHG and energy efficiency targets.	10	1
Wärtsilä Corporation	✗	✗	✓	The group operates a bonus scheme, which is implemented globally in all businesses. The bonus is based on the Group's profitability and agreed personal targets. These personal targets can include GHG related issues.	8	2

Note: Siemens, GE, KHI, MHI and Vestas do not appear to have any climate related remuneration policies.
Source: CDP

Heavy Machinery

- Only three of the seven machinery companies display any form of climate-related remuneration with none of them incentivizing executives short-term or long-term bonuses with climate-related targets. All their climate-related remuneration targets are at sub-executive level.

Figure 83: Heavy Machinery - Climate related remuneration

Company	Short Term Incentive	Long Term Incentive	Sub-executive remuneration	Description	Score	Rank
CNH Industrial	✗	✗	✓	Energy/ sustainability managers have targets on energy consumption and GHG emissions reduction and the performance evaluation contributes to the definition of variable pay e.g. reduce CO_2 emissions per unit of production by 20% by 2022 from 2014 levels.	20	1
Deere & Company	✗	✗	✓	Individual employees in positions overseeing certain aspects of Deere's climate strategy may be evaluated against performance relative to energy or GHG targets.	10	3
PACCAR	✗	✗	✓	Mention pay rises and promotions have occurred through achieving certain energy and GHG targets.	10	3

Note: Hino Motors, Hitachi Construction, Komatsu, Kubota do not appear to have any climate related remuneration policies.
Source: CDP

Figure 84: All sectors - Internal carbon price

Company	Subsector	Internal Carbon Price	Average internal carbon price (US$ / tonne CO_2)
Schneider Electric	Electrical Equipment	Yes	$34
Mitsubishi Elec	Electrical Equipment	Yes	No price disclosed
General Electric	Industrial Conglomerates	Yes	No price disclosed
Siemens	Industrial Conglomerates	No, but in the next 2 years	n/a
CNHI	Machinery	Yes	No price disclosed

Source: CDP

Internal carbon price

- Only one of the 22 companies discloses an internal carbon price.
- The only price disclosed is by Schneider Electric who use a price of 30€/tCO_2e - this is used for decisions related to energy supply and SF6 leaks.
- Mitsubishi Electric, General Electric and CNHI all claim to use a price but do not disclose the exact price level,
- Siemens intend to introduce one within two years.

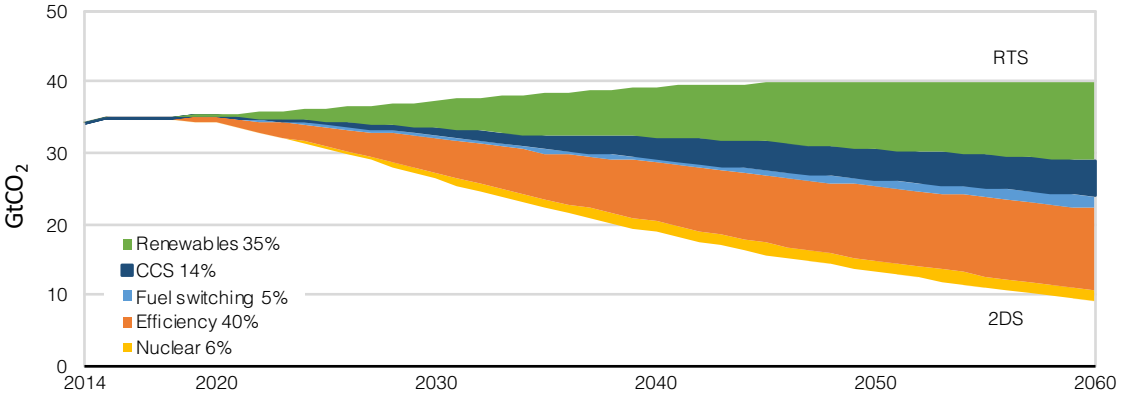
Regulation of end markets

- Several end-markets served by Capital Goods companies will be affected by changing regulations. The power sector, industry, buildings and transport are some of the areas that will see the biggest climate-driven changes in regulatory landscape.
- Energy efficiency plays a crucial role in decarbonization pathways, driving 40% of the abatement in IEA 2DS. Between 2000 and 2016, 83% of energy efficiency policy coverage was concentrated in the industrial sector, fuel standards for LDVs and space heating standards for buildings. Over the next years significant tightening will have to take place across other segments as well.
- Climate and energy policies form the core of Nationally Determined Contributions (NDCs). By 2020 the EU aims to take renewables to 20% of the energy mix and China targets a 15% share.
- Buildings emissions are expected to decline by 80-90% by 2050 to stay within 2-degree warming. Currently two-thirds of buildings globally are not subject to energy performance standards, but this is set to change as countries take actions to comply with NDCs. Technological performance will drive a large part of the emission reduction.
- Tightening regulation and changes in customer preferences in the Autos sector is driving demand for electrification products. Europe has some of the tightest regulation across markets, with companies at risk of financial penalties for non-compliance.

Energy Efficiency – A significant contributor to decarbonization of the energy sector

Energy efficiency accounts for 40% of greenhouse gas reduction in the IEA 2-degree scenario (2DS) out to 2060. The scale of the energy efficiency contribution depends on early action to avoid the long-term lock in to inefficient delivery of energy (IEA ETP 2017). Energy efficiency has led to 4 billion tones saving of CO_2 equivalent between 2000 and 2016 – 45% from OECD member countries and 47% from emerging economies. Without these emissions savings, emissions in 2016 would have been 12.5% higher.

Figure 85: Drivers of decarbonization (IEA RTS to 2DS)



Source: IEA ETP 2017

These energy efficiency gains have been made across five key areas – households, transport, industry, buildings and power. Government policy has been a key driver although progress has slowed in 2016. Mandatory energy efficiency policies include codes and standards such as building energy codes, minimum energy performance standards (MEPS) for lighting and appliances, fuel economy standards for vehicles and sectoral standards such as mandatory energy intensity standards for industry. According to the IEA's progress index, three policy types accounted for 83% of energy efficiency policy coverage between 2000 and 2016 – industrial sector savings, fuel economy standards for LDVs and space heating energy performance standards for buildings.

Transport

Transport was responsible for 28% of global final energy consumption in 2016. Historically there has been a focus on Light Duty Vehicles (LDVs) while Heavy Duty Vehicles (HDVs) accounted for 43% of road oil consumption and a fifth of total oil consumption in 2015. Between 2000 and 2015 road freight oil demand grew by 50% to 17m barrels per day. Policy is starting to kick in with coverage of global HDV energy use increasing from 1% in 2010 to 16% in 2016. However, this remains low compared to 55% for LDVs. Fuel economy standards in Canada, China, Japan and the US are leading the way with China the only country to lead the second phase of HDV fuel economy. The EU, India, Korea and Mexico are at various stages of implementing HDV standards expected around 2020. Inclusion of these countries would represent another 20% of HDV sales.

Industry

Industrial sector energy use has fallen with energy use per unit of economic output improving by nearly 20% between 2000 and 2016. The largest improvements were seen in the chemicals and vehicles sub-sectors where there is a clear divergence between gross value added and energy driven to some extent by automation and use of industrial robots. Globally vehicle manufacturing is the largest user of industrial robots (50% higher to vehicle manufacturing than to next sector). Metals and mining and chemicals come third and fourth. Basic metals which including iron and steel and aluminum delivered 15% energy intensity reductions between 2000 and 2016 with final energy use 10% lower. Non-metallic minerals largely comprised of cement manufacturing delivered energy intensity reductions of 20% and paper and printing of 14% in the same period.

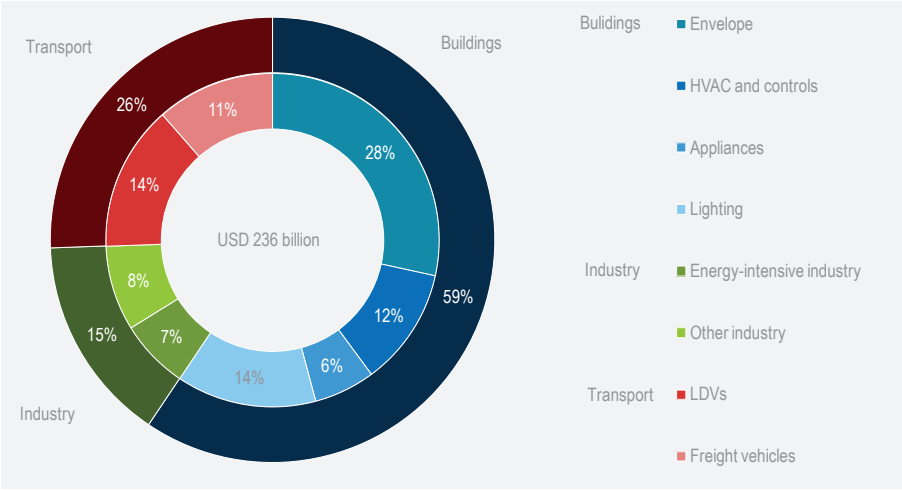
Power

Integrated and connected electricity systems are key to the transformation of the energy sector. Increasing electrification provides opportunities to enhance the flexibility, efficiency and environmental performance of electricity systems. Smart energy systems can enable demand response measures. The deployment of connected services is increasing with four billion connected services such as smart meters being used by households. One billion is expected in 2017 which may triple by 2020.

Buildings and Households

Building energy efficiency has improved but far more is possible and is the area where the vast majority of cumulative emissions reductions in the IEA 2DS occur. Efficiency improvements are possible in most countries with scope for a 10 – 20% improvement from appliances, equipment and lighting products. Connected devices could enhance the efficiency of household energy use but are dependent on consumer behavior. Other barriers remain including high installation and operating costs, lack of time variant pricing and smart grid infrastructure, privacy and security issues, market fragmentation and interoperability. Connected systems also consume energy to maintain the devices The size of global energy efficiency has been estimated at US$236 bn by the IEA with buildings being the predominant end market connection to the wider network.

Figure 86: Global energy efficiency investment, 2017



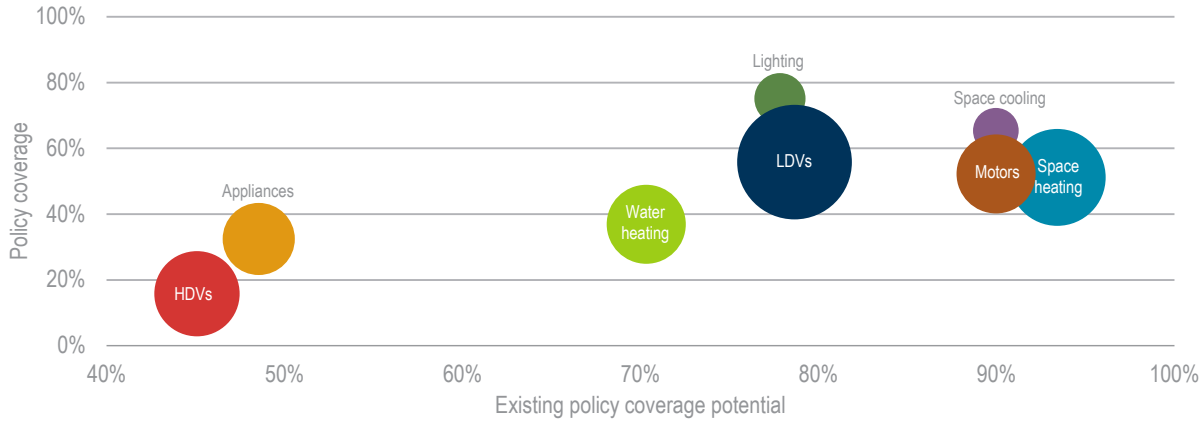
Source: IEA World Energy Investment - 2018

The size of global energy efficiency has been estimated at US$236 bn by the IEA with buildings being the predominant end market

Energy Utility Obligation Programs

Energy Utility Obligations Programs set requirements for energy suppliers to deliver efficiency outcomes, usually energy savings. Overall the energy use covered by these programs rose from 7.1% in 2005 to 18.3% in 2016. In 2005 there were only 12 obligation programs – these have risen to 45 in 2016 with programs in all 6 continents. The energy use of coverage varies from only electricity to the inclusion of natural gas and also a few programs cover transport fuel, thermal energy, process fuels and district heat.

Figure 87. Policy coverage and coverage potential of existing mandatory codes by end-use, 2016



Note: Size of bubble indicates share of global final energy consumption
Source: IEA, Energy efficiency 2017

Climate Related Policies for Advanced Vehicles

Across all of the major automotive markets, there has been growing regulatory pressure on manufacturers to reduce their fleet emissions through the development of advanced vehicles[19]. This pressure is driving demand for electrification products such as electric motors, battery packs and recharging infrastructure, presenting an opportunity for Capital Goods companies that produce this equipment.

Figure 88: Summary of country policy supports for electric vehicles

Company	Policy support for electric vehicles
China	**(1)** Plan to ban the sale of diesel and petrol vehicles in the near future; **(2)** Plan to increase the sale of advanced vehicles from 507,000 in 2017 to 7m by 2025. **(3)** Plans to introduce new-energy vehicle (NEV) share mandates of 10% for 2019 and 12% for 2020.
France	**(1)** Ban the sale of all diesel and petrol vehicles from 2040; **(2)** Car registration tax exemptions / deductions for advanced vehicles (decision devolved to regional governments); **(3)** A £10,000 grant towards a new EV when an 'old' diesel or LCV is scrapped.
Germany	**(1)** Ten-year exemption from road tax for new EVs; **(2)** Government subsidies for EVs (£4,000) and hybrids (£3,000).
India	**(1)** Plans for 30% to run on electricity by 2030.
Japan	**(1)** Battery capacity and electric range-based purchase subsidy.
Netherlands	**(1)** Tax exemptions for PHEVs and EVs; **(2)** Discounted income tax levied on ZEVs; **(3)** By 2030 all new vehicle sales will be ZEVs.
Norway	**(1)** All new private cars, city buses and light cars to be ZEVs by 2025; **(2)** Plan to halve transport emissions by 2030; **(4)** All HGVs, 75% of intercity buses and 50% of new trucks to be ZEVs by 2030.
Poland	**(1)** Aim for a stock of 1 million EVs by 2025.
South Korea	**(1)** Generous state subsidies for selected EVs (up to $12,000);
United Kingdom	**(1)** Plan to ban the sale of all diesel and petrol vehicles by 2040; **(2)** £400m of investment in EV recharging infrastructure; **(3)** £100m in additional funding for the 'Plug-in car' grant scheme.
United States	EV support is mostly devolved to state governments with the level of support varying considerably: **(1)** Ten states have ZEV mandates which require a minimum % of OEM sales to be ZEVs; **(2)** In some states, subsidies and tax exemptions are available.

Source: CDP

Climate policies affecting power generation

Climate change and energy policies represent a key driver of the low-carbon transition for utilities and their OEMs. Below we report a selection of key policy drivers that could affect positively or negatively OEMs power business.

Climate policies:

*EU:*The EU has an overarching target to reduce GHG emissions by 80-95% below 1990 levels by 2050. Underlying it are a number of medium term targets and supporting policies, with a 2030 target of 40% cut in GHG emissions from 1990 levels, at least a 27% improvement in energy efficiency, and at least a 27% share for renewable energy in overall energy consumption, including at least 45% of electricity generated from renewables.

China: with the Paris Agreement China has committed to have its CO_2 emission peak by 2030 at the latest, while lowering the carbon intensity of its GDP by 60-65% below 2005 level by 2030. In its 2016-20 five year plan China aims to decrease its reliance on coal, taking the proportion of coal in its energy mix from 64% in 2015 to 58%, with natural gas increasing from 5.9% to 10% in 2020.

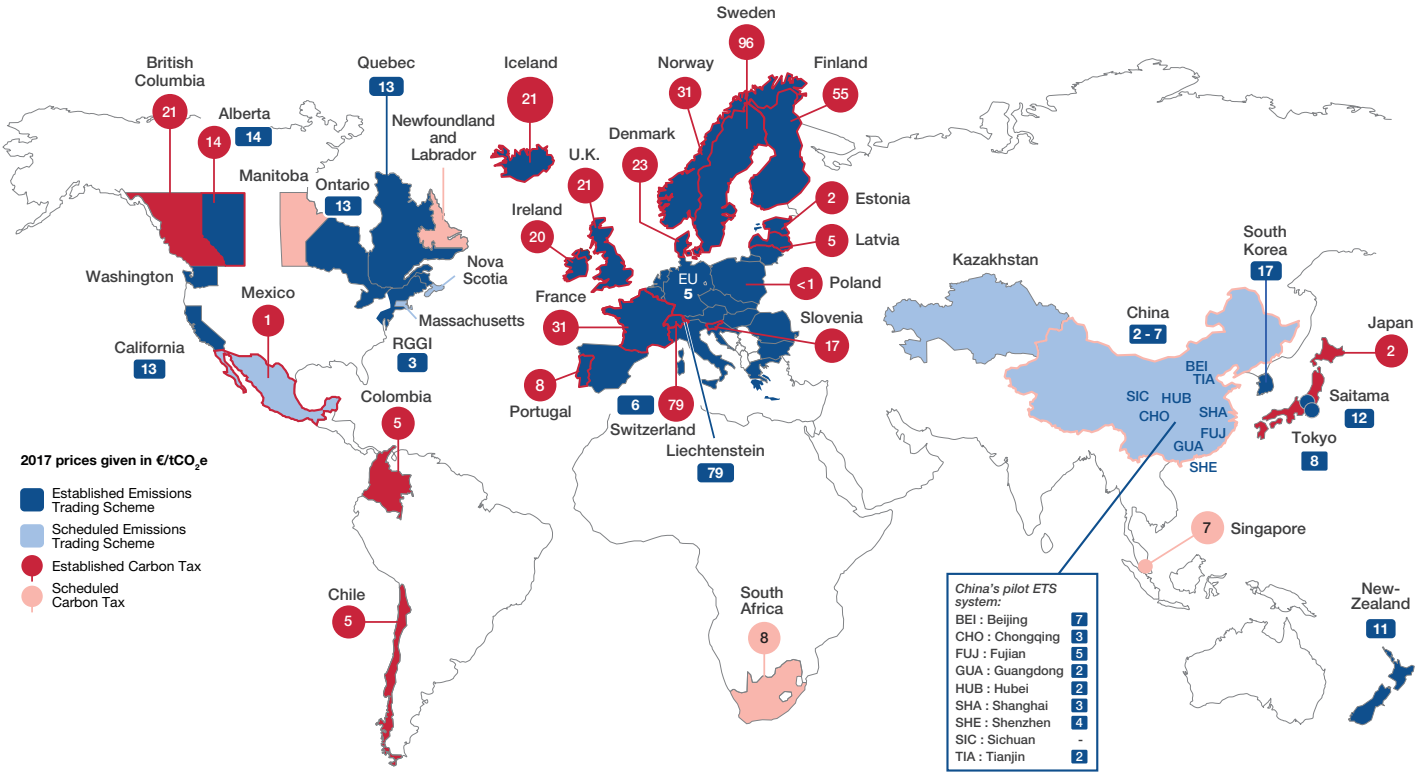
19. Advanced Vehicles is a term used to refer to a wide range of low-carbon and zero emission vehicles.

Emission Trading Schemes (ETS):

EU: The ETS is EU's key lever of climate policy. Allowances are fully auctioned for power generators except in countries that entered the EU since 2004. The surplus of emission allowances that has built up since 2009 was reduced in 2016 by "back-loading", where the auctioning of 300 million allowances from 2015 was postponed until 2019- 2020. Another fundamental change is the introduction of the Market Stability Reserve, which will start operating in 2021 and address the allowances surplus.

China: At the end of 2017 China took the first steps to launch its nationwide ETS, with formal trading expected to start in 2019. The scheme will initially only cover the energy sector, covering 3.5bn metric tonnes of CO_2 from 1700 sources including the country's coal plants. Subsequently the scheme will be rolled-out to industrial sectors and implementation is expected to start in 2020. Once fully implemented, the scheme is expected to cover 15% of total global emissions.

Figure 89: Map of ETS and explicit carbon prices around the world in 2017.



Source: Carbonbrief, Institute for Climate Economics

Renewable energy policies:

EU: By 2020, the EU Renewable Energy Directive targets a 20% share of energy from renewable sources. A range of policy instruments are being used to achieve these targets at national level, including feed-in tariffs, feed-in premiums, quota obligations, and competitive auctions.

China: In its 13th Five Year Plan period (2016–2020), China has set a 15% minimum target for the share of non-fossil energy consumption by 2020 (from 12% in 2015).

Innovation programs:

EU: The EU supports the development of low-carbon technologies with the NER300 programme providing funding for renewable energy and CCS and the Horizon 2020 scheme providing nearly £80 billion of funding for research and innovation.

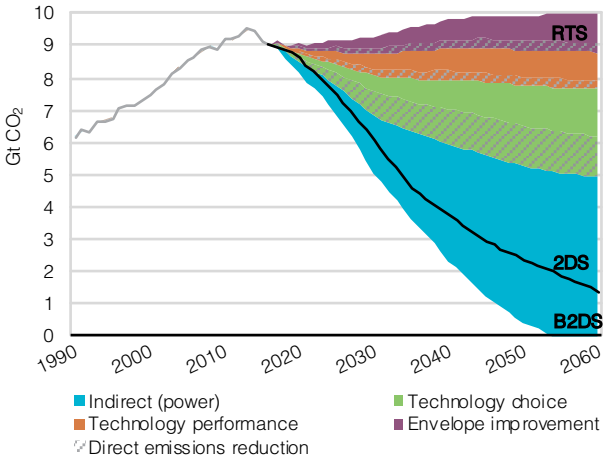
China: China's National Energy Administration (NEA) announced in January 2018 that it will spend $363bn developing renewable capacity by 2020. This investment will see renewables account for half of all new generating capacity and create 13 million jobs.

Buildings operational emissions and energy standards

The global building sector is responsible for around one-third of global final energy consumption and for approximately a quarter of global carbon emissions (IEA, 2017). To stay below the 2-degrees level, buildings emissions need to be around zero by 2050. Almost half of the reduction against the reference scenario is attributable to buildings' efficiency measures, including envelop improvements, technological choices (such as equipment and fuel choice) and technology performance.

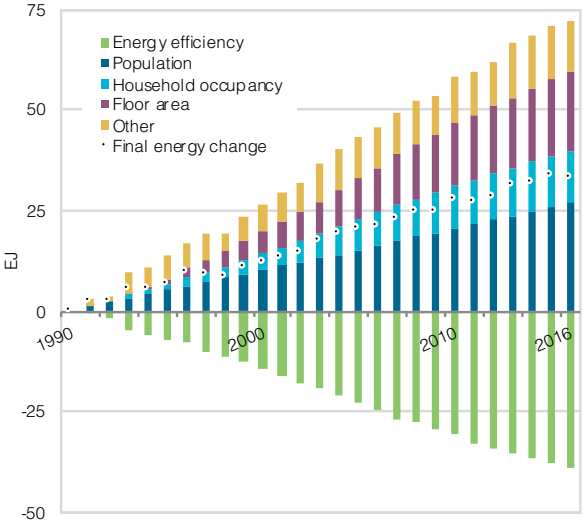
Since the Paris Agreement, almost 90 countries have put forward buildings-related actions in their NDCs. Buildings energy intensity per square meter improved globally at roughly 1.5% per year since 1990 thanks to energy efficiency technologies and energy codes. However, this trend was more than off-set by larger spaces and increased demand for energy services. Population growth also played a major role, with energy intensity per capita stable since 1990 at around 5MWh. Regional differences are still wide, with OECD countries stable at 11MWh and 3.3MWh in non-OECD countries.

Figure 90: Key contributions to CO_2 emissions reduction in buildings under a reference (RTS), 2-degrees (2DS) and beyond 2-degree (B2DS)



Source: IEA ETP 2017

Figure 91: Development of global final energy demand and its components



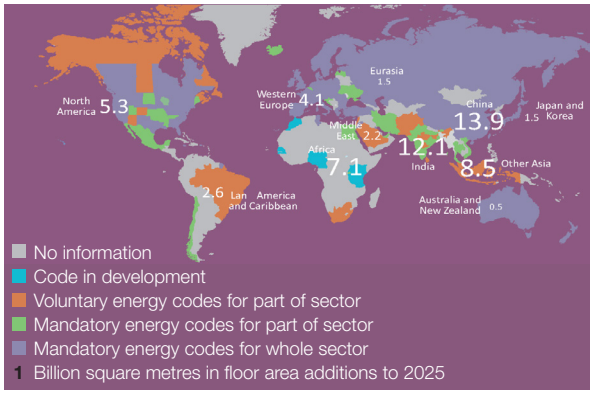
Source: IEA ETP 2017

On average, space and water heating still account for the majority of energy consumption. Improving living standards in developing economies, however, are increasing demand for cooling, lighting and household appliances. Electricity consumption in non-OECD increase 4.5 times between 1990 and 2014 (compared to stable in OECD countries).

Deep energy renovation and high qualification for new constructions are fundamental to avoid lock-in emissions of buildings. Important performance improvements can be achieved with appropriate technologies, covering household appliances and lighting, smart meters and grids, digital building automation, fuel cells and heat pumps.[20] Cost saving of 30-50% compared to standard practices of new commercial buildings (or 50-80% for more advanced technologies) can off-set the extra capital spends. Retrofits can achieve 25-70% savings in total energy use.[21]

In the EU two directives cover the reduction of energy consumption in buildings, with targets including the fact that all new buildings must be nearly zero-energy by end-2020 or that buildings sales and rental have to include energy performance certificates. Globally, two-thirds of existing buildings energy use is not subject to minimum performance standards and half of stock additions to 2060 are estimated to take place in countries that currently do not have mandatory building codes.[22]

Figure 92: Building energy codes around the world



Source: IEA ETP, 2017

Figure 93: Baker & McKenzie survey results by jurisdiction

	Green Certification	EPC & MES	IGR	CO2 & Energy Targets	Renewable Energy	Regulation	Financing	Planning	Green Leases	Total	Rank	Band
Germany	2	1	2	1	1	1	1	1	2	12 (=)	1	
United Kingdom	2	1	3	2	1	1	1	1	1	13 (↓)	2	Category 1
Netherlands	2	1	1	1	2	2	1	2	2	14 (=)	3	
France	2	1	2	1	1	2	2	2	2	15 (↓)	4	
Italy	2	1	1	1	2	2	1	4	1	15 (↑)	4	
Belgium	2	1	1	1	3	2	2	2	2	16 (NEW)	5	Category 2
Singapore	1	1	1	2	4	3	4	1	1	18 (=)	6	
Spain	2	1	1	1	1	3	3	3	3	18 (=)	6	
Canada	2	1	3	2	1	2	3	3	1	18 (↑)	6	
United States	2	2	2	1	2	3	2	2	2	18 (=)	6	
Australia	2	3	2	3	2	3	2	2	1	20 (↑)	7	
Brazil	2	3	3	2	3	3	2	1	3	22 (↑)	8	
China	2	2	2	2	3	3	2	2	4	22 (=)	8	
Czech Republic	3	2	3	2	1	2	4	3	2	22 (↓)	8	Category 3
Sweden	2	1	4	2	1	2	3	4	3	22 (NEW)	8	
Ukraine	2	3	3	3	3	3	2	2	3	24 (NEW)	9	
Taiwan	2	3	3	3	2	3	4	1	4	25 (NEW)	10	
Hong Kong	2	1	4	2	4	4	4	3	3	27 (↑)	11	
Poland	2	2	4	3	3	4	4	2	3	27 (NEW)	11	
Russia	2	3	3	3	3	3	3	3	4	27 (NEW)	11	
Colombia	3	3	4	3	4	2	2	3	4	28 (NEW)	12	
Mexico	4	4	3	4	2	3	2	4	3	29 (↑)	13	Category 4
Malaysia	2	3	4	3	4	3	4	4	3	30 (NEW)	14	
United Arab Emirates	2	4	4	3	3	4	4	4	4	32 (=)	15	
Chile	3	4	4	4	4	4	4	4	4	35 (NEW)	16	

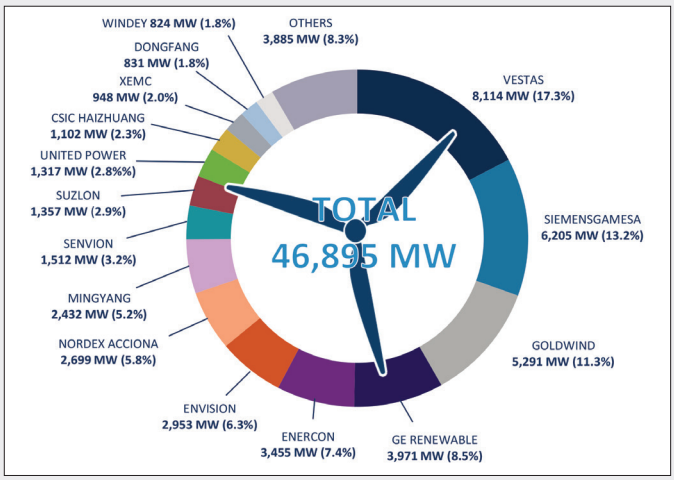
Source: Baker & McKenzie, 2016

20. IPCC, 2014
21. Levine et al, 2007; Harvey, 2009
22. IEA, ETP, 2017

Geographical diversification in wind turbines OEMs

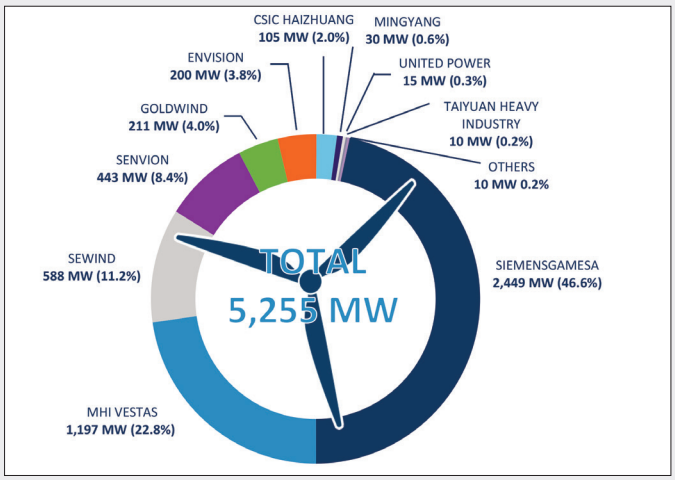
The four wind companies included in this report (General Electric Renewables, Siemens Gamesa, Vestas and MHI Vestas Offshore Wind) cover around 42% of global wind power market share, with a 39% share in on-shore and around 70% in off-shore wind. Vestas maintained the lead in 2017 with 8.7 GW installed (16.7% market share), immediately followed by SG (16.6%), which increased its annual market share year-on-year by 3.4% (+0.9% for Vestas). GE Renewable on the other hand lost 4.5% of market share in the year, installing 4GW or 7.6% of global supply (FTI Intelligence, 2018).

Figure 94: Annual on-shore wind turbine suppliers



Source: FTI Intelligence

Figure 95: Annual off-shore wind turbine suppliers



Source: FTI Intelligence

Geographical diversification varies between the groups, with GE the most concentrated (with highest concentration in the US and the lowest number of countries of exposure) and Vestas at the other end (least concentrated, with no more than 30% exposure to any country) with SG somewhere in between.

Figure 96: Top five wind turbine suppliers in the top 10 markets

Rank	Market	#1	#2	#3	#4	#5	New MW installed
1	China						19,832
2	Germany		VST (19%)	SG (18%)			6,764
3	US	VST (39%)	SG (25%)	GE (23%)			6,290
4	UK	SG (46%)	MVOW (24%)	VST (12%)			4,239
5	India		SG (27%)				3,668
6	Brazil	GE (35%)	SG (22%)	VST (20%)			2,188
7	France	VST (32%)				SG (9%)	1,787
8	Turkey	SG (28%)		GE (24%)	VST (15%)		883
9	Ireland	SG (51%)		VST (17%)		GE (2%)	649
10	Finland	VST (62%)		SG (15%)			474
Total top 10							**46774**

Source: CDP

To try and assess how the existing geographical footprint could expose these companies to different growth prospects in a 2-degree scenario, we mapped companies' global presence against wind power growth projections by region in IEA's 2DS between 2014 and 2030 (ETP 2017). We assumed that market share and geographical presence remain unchanged overtime. Below we present a summary of the results.

Figure 97: Exposure to future growth based on geographical footprint: SG and Vestas exposed to similar potential

	ONSHORE				OFFSHORE:				ON+OFF:
A: 35,548 TWh (cum onshore 2014-30) F: 3,344 TWh (cum offshore 2014-30)	B Weighted region score	C=BxA Cum 2014/30 regional power	D 2017 mkt share	E=CxD Exposure to growth (TWh)	G Weighted region score	H=FxG Cum 2014/30 regional power	I 2017 mkt share	J=HxI Exposure to growth (TWh)	K=E+J Total exp to growth (TWh)
GE	17.6%	6,251	8.50%	531					531
SIE	17.8%	6,330	13.20%	836	42.4%	1,418	46.6%	661	1,496
VST	21.2%	7,537	17.30%	1,304	42.4%	1,418	11.4%	162	1,466
MHI					42.4%	1,418	11.4%	162	162

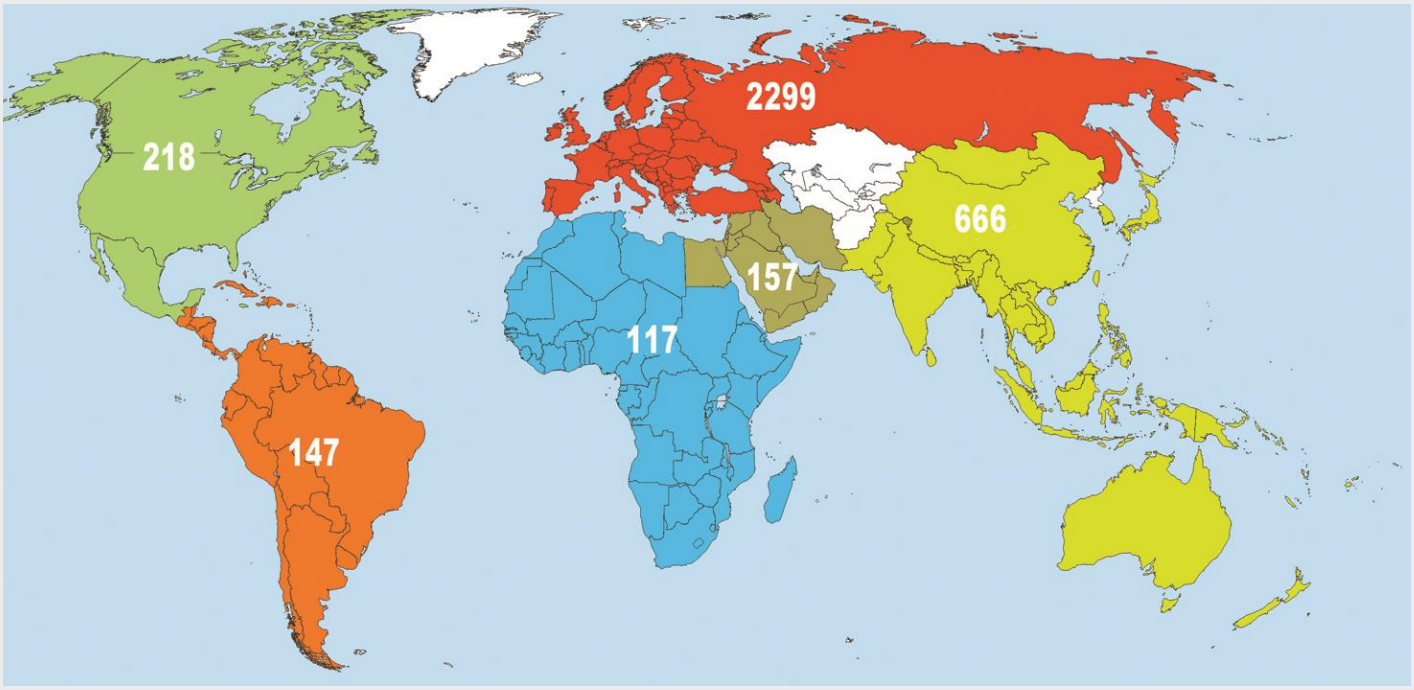
Source: CDP

In on-shore, Vestas appears best placed (column E), mainly thanks to its exposure to China and Europe. GE lies at the other end due to the elevated exposure to Brazil and partly to the US' lower growth market. SG's on-shore portfolio geographical footprint shows similar growth potential to GE's. The picture changes when we add in off-shore's growth prospects (col J), dominated by SG with almost a 47% share in a market that is expected to grow very steeply. It is highly unlikely that SG could retain the current market share as off-shore markets mature, hence our estimate indicates an upper bound, but gives an idea of the potential ahead. When adding on and off-shore market growth potential (column K), SG and Vestas appear exposed to similar capacity growth potential.

The use of Minimum Efficiency Performance Standards

The use of Minimum Efficiency Performance Standards (MEPS) to regulate Energy Using products (EuP) has for decades been standard practice for many of the world's largest economies. In most instances these standards are mandatory and undergo regular review to ensure they are in line with current technological trends. Often, they are accompanied by efficiency labelling designed to provide greater salience to customers on the efficiency of EuPs. This acts as an incentive for Original Equipment Manufacturers (OEMs) to see the MEPs as a floor for energy efficient products and not simply as a benchmark.

Figure 98: Annual on-shore wind turbine suppliers



Source: Australian Department of Industry

Since 2004 the number of global MEPs and Labelling policies has increased threefold from 431 to around 1,453 in 2013 with most of these measures being introduced in Europe and the Asia-Pacific regions. In total close to 4,000 energy efficiency measures have been introduced with the emerging and frontier economies in Africa and the Middle East experiencing the highest growth rates.

In Europe, the introduction of the Eco-design directive in 2009 provided the basis for harmonised labelling and standards for select products across the EU's internal market; covering a mixture of electrical components, household appliances and industrial products.

Japan has had a long-standing MEPs program with the introduction of the Energy Conservation Act in 1979. However, in 1999 introduced the Top Runner Program which encourages manufacturers to achieve a minimum standard of efficiency over a given time period, with the future target determined by the most efficient model of the day. This policy has coincided with significant efficiency gains in the technologies covered by this policy.

Like Japan, China has a long history of using MEPs to regulate EuPs but has expanded their coverage and rigour since their initial introduction under the Energy Performance Standards Program in 1989. As a consequence, China has now overtaken the US and Canada as the country with the most Energy Efficiency Measures[23]. The trend of economic development giving rise to more stringent MEPs is especially pertinent to other emerging and frontier economies, many of whom rely on voluntary standards for EuPs (e.g India). In addition to growing MEPs at a regional level, the products for which these standards are applicable have also increased by around 14% with 55 product types directly regulated in 2013. Refrigerators, Air Conditioners and Lighting continue to be the products subject to most scrutiny.

Although many capital good companies are not directly exposed to products subject to these standards, many of the components they manufacture (e.g. electric motors, semiconductors, power modules etc.) are used to produce these items. The regulatory impact of MEPs on Capital Goods companies are likely to be felt through the selective pressure of OEMs as they seek to use energy efficient components to produce more efficient products. In addition to this, the IEA show that there is significant scope for further expansion of regulatory codes and standards for EuPs. With Energy Efficiency savings expected to account for over 40% of emissions savings under the 2DS scenario, we can expect there to be some convergence between the actual and potential MEPs coverage for these products as countries seek to implement their commitments to the Paris Agreement. Tightening and increasing coverage of regulatory standards present an opportunity for companies to take advantage of the revenue opportunities that come from an energy efficient product portfolio.

23. Includes MEPs, Comparative and Endorsement Labelling.

Supplementary Figures

Figure 99: Electrical Equipment - High growth market metrics

Metric	Sub-metric	Denominator	Description
Demand for Electrification Products	Access to electricity (% of population)	Total Population	Increased access to electricity relies on developing the T&D network. Countries with a large population and relatively low access to electricity that are making rapid progress in closing this gap can be considered HGMs for T&D products.
	Electric power transmission and distribution losses (% of output)	Electric power consumption (kWh per capita)	Countries that have an inefficient T&D network but have made rapid progress in closing this gap can be considered HGMs for High-Voltage products.
	Urban Population (% of Population)	Total Population	As urban populations increase demand for low-medium voltage products within buildings will increase. The number of people that live in urban environments is a good proxy for the size of this market. Countries that have a large and fast growing urban population can be considered HGMs.
Demand for Automation & Digitalization Products	Annual Shipments of Multipurpose Industrial Robots	Car Production	According to the IFR 35% of demand for industrial robotics is driven by the Automotive sector. With 30% from Electrical Equipment and the rest from other industries. Due to limited data availability we have only been able to use vehicle production as proxy for the size of a countries' market for these products and their associated technologies.
	Cumulative Smart meter installations	No. of Households	Countries with a large number of households that are forecast to rapidly increase the penetration rate of smart meter technologies can be considered HGM for smart meters and their associated technologies.

Source: CDP

Figure 100: Heavy Machinery - High growth market metrics

Metric	Sub-metric	Denominator	Description
Demand for agricultural machinery	Arable land (% of land area)	Total land area (sq. km)	Countries and regions with high/growing proportions of agricultural land as a % of total land area produce more agricultural commodities, and are therefore more reliant on greater use of agriculutral machinery.
Demand for mining and construction machinery	Ores and metals exports (% of merchandise exports)	Total merchandise exports (current US$)	Countries with a high/growing level of ore and metal exports as a proportion of merchandise exports, will rely more heavily on mining and construction machinery to extract these commodities.
Demand for HGV transportation	Urban Population (% of Population)	Total Population	Countries with high and growing international trade in goods, will rely more heavily on transport and distribution fleets.
	Annual Shipments of Multipurpose Industrial Robots	Car Production	

Source: CDP

Figure 101: Electrical Equipment - High growth market regional scores

Region	Automation & Digitalization Score	Electrification Score	Overall
Asia-Pacific	6.35	6.29	6.32
RoW	5.63	6.26	5.95
North America	5.07	6.80	5.93
Americas	5.21	6.39	5.80
Latin America	5.35	5.97	5.66
Europe / MENA	5.45	5.54	5.49
Europe	5.26	4.81	5.04
Weighting	**50%**	**50%**	

Source: CDP

Figure 102: Heavy Machinery - High growth market regional scores

Region	Arable	Mining	HGVs
Africa	6.42	5.50	5.95
North America	6.25	4.50	5.94
Latin America	6.43	6.73	5.50
Europe	4.77	6.43	5.06
Asia-Pacific	6.64	5.00	4.13
Middle East	4.06	4.33	4.04
Europe	5.26	4.81	5.04

Weighting: Weightings are calculated based on company revenue exposure to the three sub-metrics.

Source: CDP

Note: This metric is designed to act as an indicator of High Growth Markets for the themes and technologies analysed in the respective industries. The underlying metrics that are used to calculate the scores for each region are proxies and do not account for a range of economic and political considerations that will affect the growth potential for different markets.

Appendix I: Company performance traffic light chart

Company performance overview

		Electrical Equipment								Industrial Conglomerates							Heavy Machinery							Weighting	
	League Table rank	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	1	2	3	4	5	6	7		
	Companies	Schneider Electric	Mitsubishi Electric	ABB	Eaton	Johnson Controls Intl.	Nidec	Rockwell Automation	Emerson Electric	Vestas	Siemens	Honeywell International	Kawasaki Heavy Industries	Mitsubishi Heavy Industries	General Electric	Wärtsilä	CNHI	Kubota	Hitachi Construction	Deere & Company	Hino Motors	Komatsu	PACCAR	Metric	Area
	Transition risks rank	1	2	8	4	3	5	6	7	1	3	4	2	7	6	5	2	1	7	6	4	3	5		**30%**
Transition risks	S1+2 Emissions Intensity	3	5	1	6	8	7	2	4	1	2	5	7	6	3	4	4	6	1	7	2	3	5	10%	
	S3 Intensity & Disclosure	1	3	6	4	2	5	7	8	1	4	5	2	7	7	3	3	4	6	7	1	2	5	50%	
	Energy Intensity	3	2	4	5	8	7	6	1	1	3	6	7	5	2	4	3	6	2	7	5	1	4	10%	
	Business Resilence	6	5	8	4	7	3	1	2	1	4	2	5	6	3	7	3	1	7	2	6	5	4	30%	
	Transition opportunities rank	2	1	3	5	8	4	7	6	2	1	3	6	4	5	7	3	1	2	4	5	6	7		**45%**
Transition opportunities	Low Carbon Product Scorecard	1	2	2	4	7	5	8	6	3	1	2	6	5	4	7	1	2	3	4	5	6	7	70% (40%)(i)	
	R&D	2	3	5	6	8	4	1	7	7	1	3	5	4	2	6	4	5	6	1	2	3	7	15% (15%)	
	Patent Analysis	7	1	3	5	8	4	2	6	1	4	5	3	2	7	6	6	3	1	5	2	4	7	15% (15%)	
	Divisional Breakdown	n/a								1	3	2	4	5	6	7	n/a							n/a (30%)	
	Climate governance & strategy rank	1	2	5	4	3	6	7	8	1	2	3	5	6	7	4	2	5	6	3	4	1	7		**25%**
Climate governance & strategy	Climate Related Remuneration	1	4	4	2	3	4	4	4	3	3	1	3	3	3	2	1	4	4	2	4	4	2	10%	
	Board Level Climate Expertise	1	6	3	5	3	2	7	8	1	3	2	6	4	7	5	5	2	5	1	2	2	7	25%	
	Use of internal carbon price	1	2	3	3	3	3	3	3	3	2	3	3	3	1	3	1	2	2	2	2	2	2	5%	
	Emission Reduction Targets	3	1	4	7	2	6	5	8	2	3	5	6	7	4	1	5	6	3	7	2	1	4	25%	
	Supplier Engagement	4	2	5	1	2	6	6	6	1	2	5	3	4	7	5	3	4	7	1	6	2	5	25%	
	CDP Score	2	1	5	3	4	7	6	7	7	1	3	2	4	6	5	3	5	4	7	6	1	2	10%	
Total	Green	6	6	2	1	3	0	3	1	9	4	3	2	1	3	1	4	3	4	4	4	4	1		
	Yellow	4	5	4	5	2	4	1	2	1	8	4	2	3	3	4	7	4	4	2	3	5	5		
	Orange	2	2	5	7	5	5	4	7	3	2	7	10	8	5	6	2	6	2	5	5	3	3		
	Red	1	0	2	0	3	4	5	3	1	0	0	0	2	3	3	0	0	3	2	1	1	4		

This heat map is designed to help investors pinpoint priority areas for engagement.

Green = good performance
Yellow = reasonable performance
Orange = monitor performance, possible concern
Red = area of concern, engage with company

We have not assigned a uniform number of green, yellow, orange and red colours across the metrics according to rank. Instead, we have reviewed the results of each metric in detail and assigned the above colours according to the underlying values for each metric.

(i) Weighting for Industrial Conglomerates shown in brackets
Source: CDP

Appendix II: Company summaries - Electrical Equipment

Emerson Electric

Average market cap 2017: US$ 42 bn

Country: USA

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
EMR US	8	7	6	8

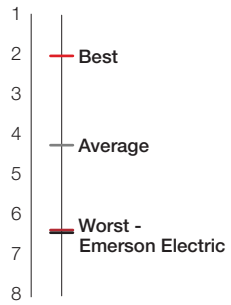
Company strengths

- Has the highest EBITDA margin of the universe of Capital Goods companies and combined with its short cycle exposure makes the company more resilient to changes in end market demand.
- Smallest portfolio of low-carbon products but has some important technologies such as behind the meter solutions, control infrastructure for power management – all important growth markets for buildings and decentralized power.

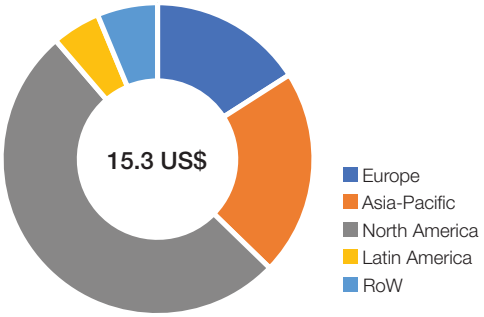
Company weaknesses

- The company generally has lower quality disclosure with no measurement of Scope 3 Use of Goods and as a result no targets.
- The company performs poorly on our governance and strategy metrics with no supplier engagement, life cycle analysis and poorest scoring on board level expertise.
- While benefitting from growth markets driven by efficiency does not appear to have a structured approach to capitalize on these trends which could result to exposure in disruption to end markets.

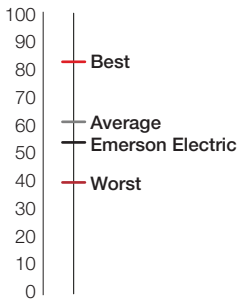
S3 Intensity & Disclosure weighted rank



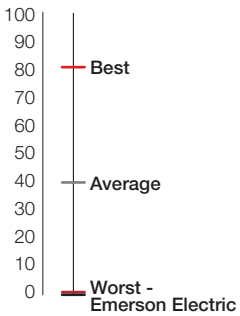
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Rockwell Automation

Average market cap 2017: US$ 23 bn

Country: USA

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
ROK US	7	6	7	7

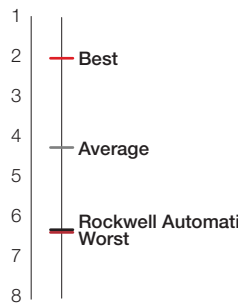
Company strengths

- One of the highest R&D to sales of the group and highest margins reflecting the exposure to software businesses at a system level.
- The company ranks second in patent analysis although Mitsubishi Electric leads by a wide margin – patents filed for automation, connectivity and digitalization as well as efficiency represent the largest proportion.

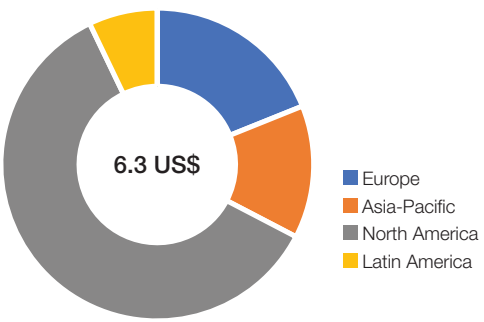
Company weaknesses

- While the company has some exposure to radical technologies such as control infrastructure for energy efficiency of energy intensive industries – most of its top 10 technologies are incremental in nature.
- No disclosure of Scope 3 emissions apart from business travel and no evidence of measurement and management of Scope 3 emissions, supplier engagement and life cycle analysis.

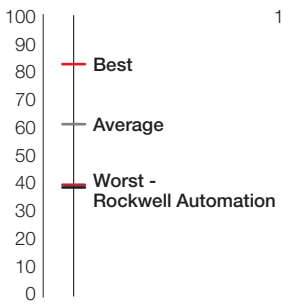
S3 Intensity & Disclosure weighted rank



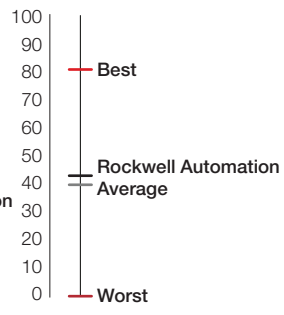
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Nidec

Average market cap 2017: US$ 40 bn

Country: Japan

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
6594 JP	6	5	4	6

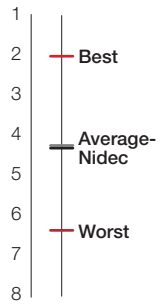
Company strengths

- Nidec is exposed to a number of high growth markets with products that are predominately short cycle in nature; making them one of the more resilient companies in the sub-group.
- The company has an R&D expenditure to net sales that is above average for the subsector and ranks fourth for the number of high quality patents filed for low-carbon technologies.

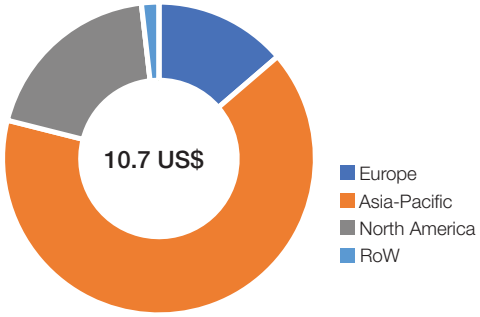
Company weaknesses

- Nidec has recently started reporting on Scope 3 emissions from Purchased Goods & Services but at present do not report on their Scope 3 emissions from the Use of Sold Products.
- The company has made good progress in reducing their overall energy intensity but the current level is still almost 80% higher than its peers in the subsector.
- Although the company has a high level of board level climate expertise it lacks any kind of climate related remuneration package and has a S1+2 emission reduction target that lacks ambition.

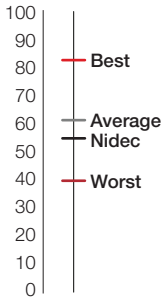
S3 Intensity & Disclosure weighted rank



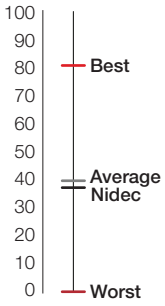
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Johnson Controls International

Average market cap 2017: US$ 36 bn

Country: USA / Ireland

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
JCI US	5	3	8	3

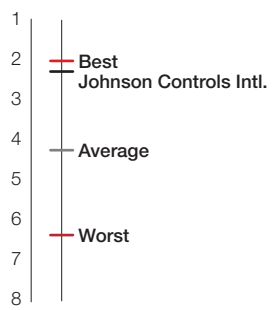
Company strengths

- The 2016 merger with Tyco makes JCI well placed, to offer a holistic portfolio of integrated building technologies and solutions. JCI's Distributed Energy Storage technologies coupled with building automation and connectivity products present an opportunity for them to facilitate systemic changes in building design through power solutions and smart technology.
- JCI has excellent disclosure of Scope 3 emissions covering both Purchased Goods & Services and Use of Sold Products, with an S3 intensity well below the average for the subsector.
- The company's climate governance is among the best and ranks third overall with a meaningful S1+2 emission reduction target, good board level expertise on climate change and a level of supplier engagement that is well above average for the sub-sector.

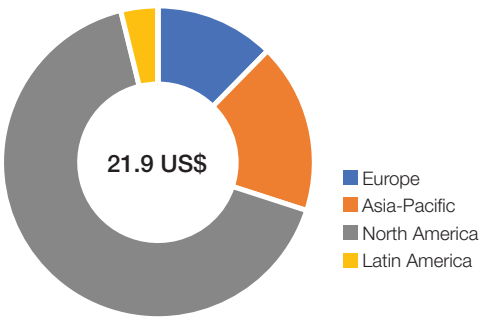
Company weaknesses

- R&D expenditure to net sales is the lowest in the subsector by some margin at 1.2% and the lowest amongst all 22 companies. This is also reflected in the high-quality patent count for key low-carbon technologies.
- JCI have a large number of incremental and radical technologies that relate to building automation and energy management systems but lags behind its peers when it comes to developing transformative technologies and solutions.

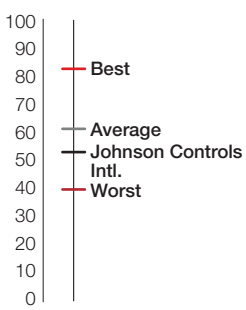
S3 Intensity & Disclosure weighted rank



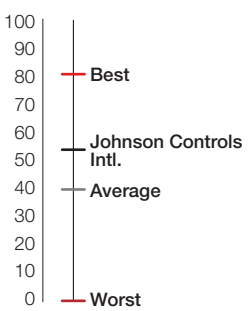
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Eaton

Average market cap 2017: US$ 34 bn

Country: USA

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
ETN US	4	4	5	4

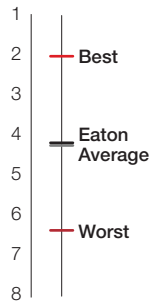
Company strengths

- The company is well positioned to capture trends in demand for low-carbon technologies – investing in transforming technologies such as microgrids.
- The company has good disclosure and management of Scope 3 emissions and has committed to a Science Based Emission Reduction target.
- Scores well against a range of climate governance and metric – 100% engagement with suppliers and life cycle analysis, reasonable board level expertise and one of the few companies with remuneration linked to emission reduction (S1+2). The company is also committing to a SBT.

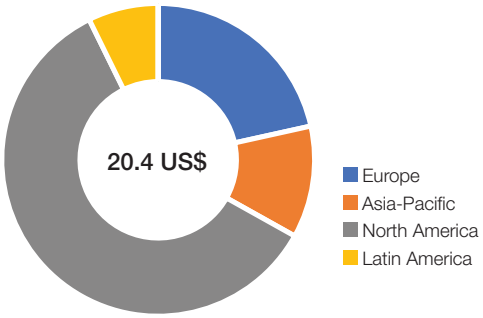
Company weaknesses

- While Eaton comes fourth on a relative basis the company has a strategy attuned with low-carbon technology options.
- The company has predominantly transformative and radical technologies in its top 10 technologies identified there remains exposure to more incremental technologies.

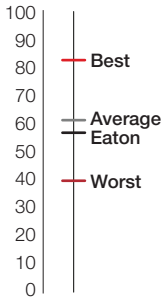
S3 Intensity & Disclosure weighted rank



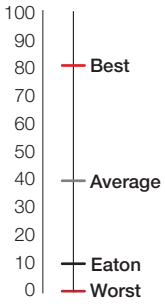
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



ABB

Average market cap 2017: US$ 54 bn

Country: Switzerland

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
ABBN VX	3	8	3	5

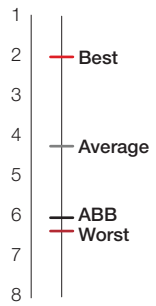
Company strengths

- The company does well in terms of innovation with a number of technologies which could be transformative – microgrids, smart internet of things to optimize power generation and behind the meter solutions.
- The company is active in EV charging infrastructure which pushes forward the adoption of advanced vehicles.
- R&D spend and high quality patents support the innovation profile of the company.

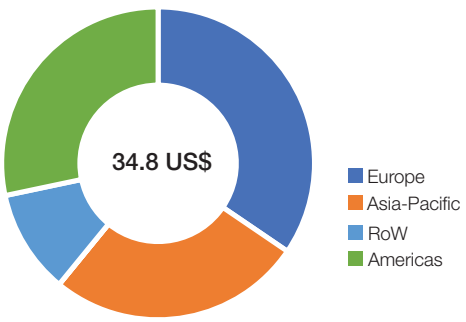
Company weaknesses

- For company with a technology suite well aligned with low-carbon technologies, the company has generally a poor level of disclosure.
- There is no reporting on Scope 3 emissions on Use of Sold Products with the main reporting in this area for business travel which is a small percentage of all Scope 3 emissions categories.
- The company only conducts very limited life cycle analysis on its product suite which is disclosed and there is no supplier engagement as disclosed to CDP.

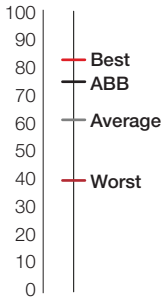
S3 Intensity & Disclosure weighted rank



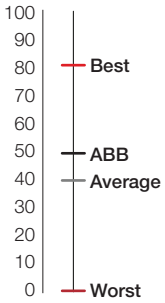
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Mitsubishi Electric

Average market cap 2017: US$ 34 bn

Country: Japan

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
6503 JP	2	2	1	2

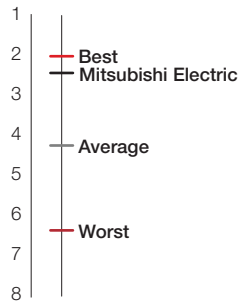
Company strengths

- The company comes a close second to Schneider, leading in a number of ways across a range of metrics.
- The company has a diverse range of products with the largest portfolio of low-carbon products and the highest filing of patents by a large margin – 60% linked to trends in automation, connectivity and digitalization.
- The company discloses on Scope 3 emissions target and has been actively managing Scope 3 emission reduction for finished products that account for 114 of 260 product groups.

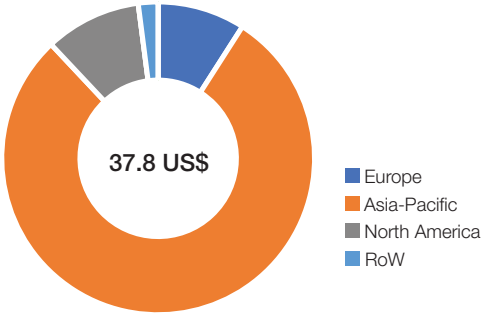
Company weaknesses

- While the company is a strong performer overall and has exposure to growing markets, margins are relatively low compared to its peer group.
- The company has positioned itself strategically for a growth in low-carbon technologies, there is limited board level expertise and no linkage of board or senior level remuneration to climate related performance.

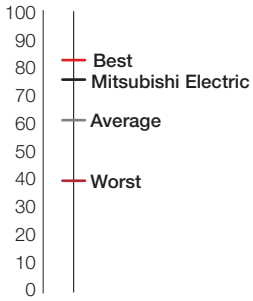
S3 Intensity & Disclosure weighted rank



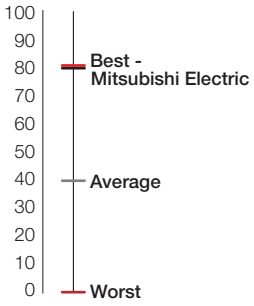
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Schneider Electric

Average market cap 2017: US$ 50 bn

Country: France

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
SU FP	1	1	2	1

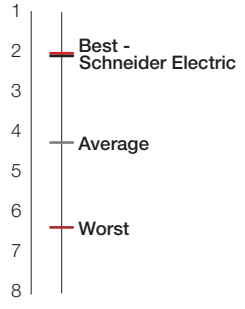
Company strengths

- Schneider ranks first overall topping Transition Risk and Climate Governance & Strategy with excellent S3 disclosure, the lowest S3 emissions intensity of the subsector and the highest ever score for climate related remuneration across our research series.
- Schneider has a product suite that is well positioned to drive systemic changes in energy systems with micro grid solutions, energy storage and other relevant technologies.
- Schneider has done well integrating climate change into their business strategy with good board level climate expertise and an ambitious S1 + 2 target. It is also among the few companies that have committed to the SBTi and is in the process of creating a Scope 3 emissions reduction target as part of this commitment.

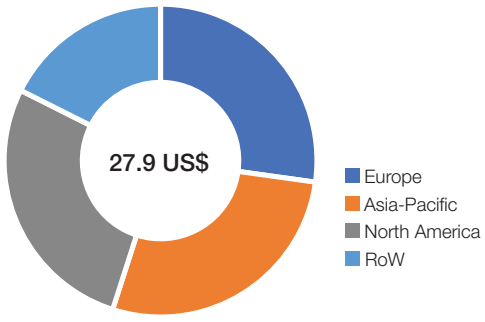
Company weaknesses

- Schneider is a top performer, but their margins are average for the subsector and whilst a large percentage of their products can be considered short cycle or secular, their exposure to high growth markets in these technologies lags behind their peers.

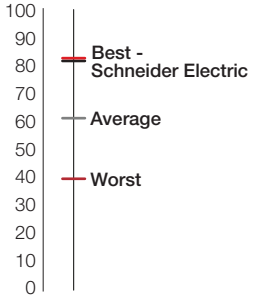
S3 Intensity & Disclosure weighted rank



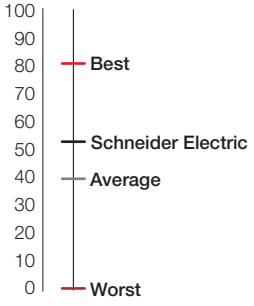
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Industrial Conglomerates

Wärtsilä

Average market cap 2017: US$ 13.1 bn

Country: Finland

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
WRT1V FH	7	5	7	4

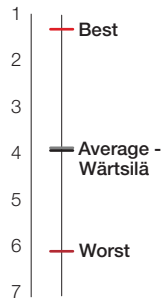
Company strengths

- Flexible, smaller power solutions easy to integrate with renewable energy sources.
- Product suite includes some transformative and radical technologies (e.g. hybrid marine systems, smart & micro-grids, conventional/solar utility scale integration).
- It ranks fourth best on governance, being one of only two IC companies with Scope 3 reduction targets and sub-exec climate-related remuneration.

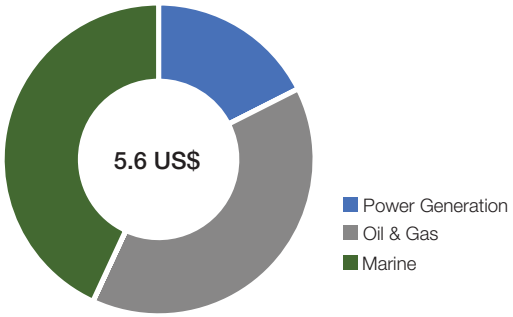
Company weaknesses

- Ranks last in transition opportunities, with the largest exposure to sectors with the low growth potential (power, oil & gas). It also has the least innovative top 10 product suite, focused on incremental technologies for low-growth markets.
- Wärtsilä also has the second-lowest R&D intensity and the lowest score in our patents analysis.
- Ranks third-last in transition risks, with only partial disclosure of Scope 3, a product suite exposed to long-cycle capex, and deteriorating Scope 1+2 intensity levels.

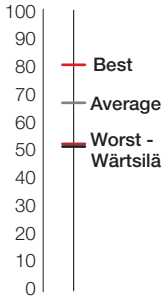
S3 Intensity & Disclosure weighted rank



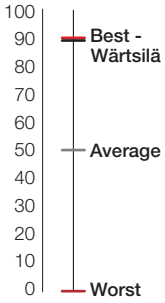
Revenue split by division



Low-carbon Product Score



Emission Reduction Targets Score



General Electric

Average market cap 2017: US$ 172.0 bn

Country: USA

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
GE US	6	6	5	7

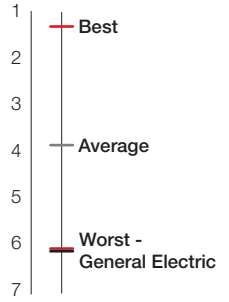
Company strengths

- Third largest on-shore wind turbines OEM globally.
- Benefits from the third highest R&D intensity (4.6%) and has several radical technologies in the electrification/ digitalization space in its product suite.
- Ranks third on Scope 1+2 intensities and second in energy intensity, with a steep decline observed over the 2012-17 period.

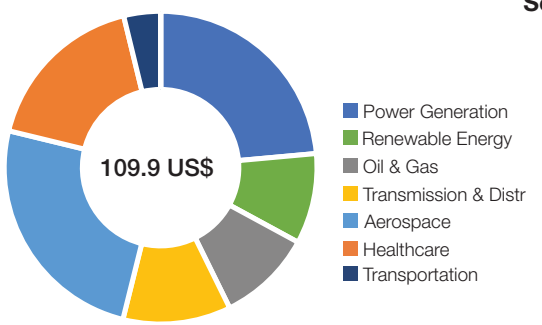
Company weaknesses

- Ranks second last on our divisional analysis, with more than a third of revenues derived from low growth markets (power, oil & gas). The new structure (ex Healthcare and BHGE) improves somewhat GE's profile but leaves significant exposure to the power segment.
- Ranks bottom in governance, with no board-level climate-expertise, no climate related remuneration, poor climate-risk management and limited supplier engagement.
- Ranks second last in transition risks, mainly due to lack of disclosure of the main Scope 3 categories.

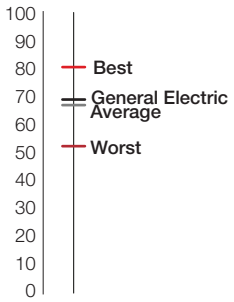
S3 Intensity & Disclosure weighted rank



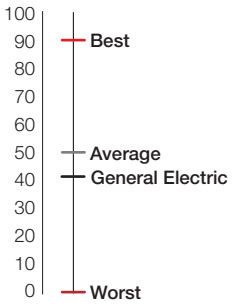
Industrial revenue split by division



Low-carbon Product Score



Emission Reduction Targets Score



Mitsubishi Heavy Industries

Average market cap 2017: US$ 13.1 bn

Country: Japan

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
7011 JP	5	7	4	6

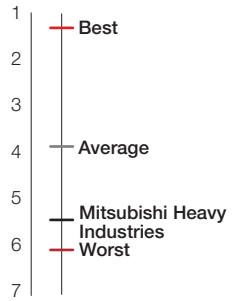
Company strengths

- Through its JV with Vestas (MVOW), MHI is the second largest off-shore wind turbine OEM, a market with strong growth potential.
- Its product portfolio benefits from several radical technologies, including CCS, fuel cells, energy digitalization technologies, geothermal and hydro power turbines.
- The company has the second highest score on our patent analysis with high quality 96 patents per 10,000 employees.

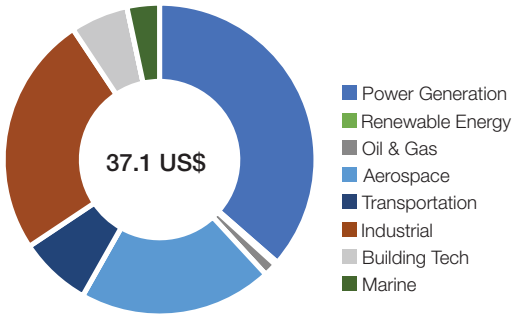
Company weaknesses

- Ranks last in transition risks, mainly being one of two companies with lack of disclosure of the main Scope 3 categories. Scope 1+2 intensity is average but has deteriorated over the period 2012-17. Energy intensity is below average but has also deteriorated over the period.
- Ranks second-last in governance, with no emissions reduction targets, limited board-level climate expertise and limited supplier engagement.
- Its business mix is the third most heavily weighted toward low-growth markets, and its product suite is relatively more exposed to long-cycle capex than the group average.

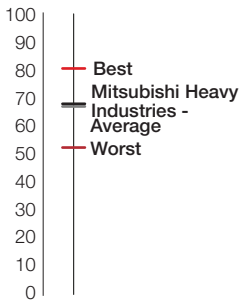
S3 Intensity & Disclosure weighted rank



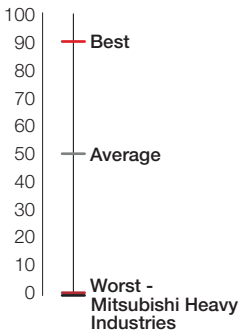
Revenue split by division



Low-carbon Product Score



Emission Reduction Targets Score



Kawasaki Heavy Industries

Average market cap 2017: US$ 5.5 bn

Country: Japan

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
7012 JP	4	2	6	5

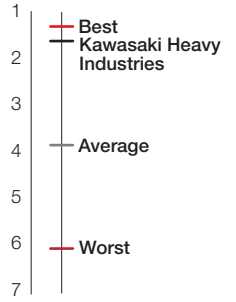
Company strengths

- Ranks second-best in transition risks, primarily thanks to good disclosure of Scope 3 emissions.
- Its product portfolio benefits from some radical technologies, including energy storage systems, hydrogen and LNG technologies and large-scale robots.
- In governance, the company scores well in supplier engagement, engaging with 15% of their suppliers on climate change and performing life-cycle assessment on a portion of their product suite

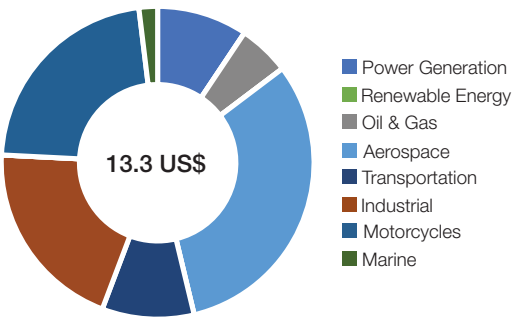
Company weaknesses

- Ranks third-last on governance & strategy. It has no climate related remuneration, no board climate expertise, low quality CO_2 reduction targets and limited climate risk management.
- Ranks second-last in transition opportunities, with the second weakest top-10 product suite. Despite some radical technologies, the majority is incremental and focused on low-growth sectors (e.g. power, motorbikes).
- Its business mix is the second most heavily weighted toward low-growth markets, and its product suite is relatively more exposed to long-cycle capex than the group average.

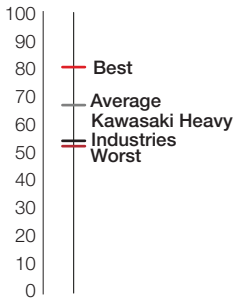
S3 Intensity & Disclosure weighted rank



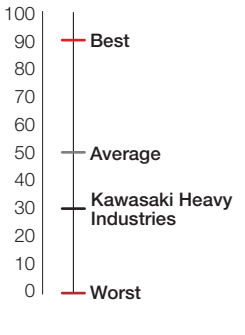
Revenue split by division



Low-carbon Product Score



Emission Reduction Targets Score



Honeywell

Average market cap 2017: US$ 110.1 bn

Country: USA

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
HON US	3	4	3	3

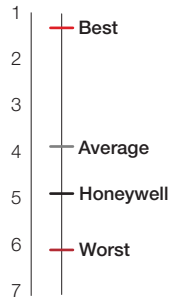
Company strengths

- Second-most exposed business to growth markets, driven by buildings systems, industrial digitalization and electrification, aerospace, with limited exposure to high emitting sectors.
- Its top-10 product suite scores second-best, with a wide range of low-carbon innovations, including smart grid controls, IoT frameworks, energy digitalization technologies and green fuels.
- Second highest R&D intensity.
- It ranks third in governance, with the best climate-related remuneration and 2nd-best board level climate management.

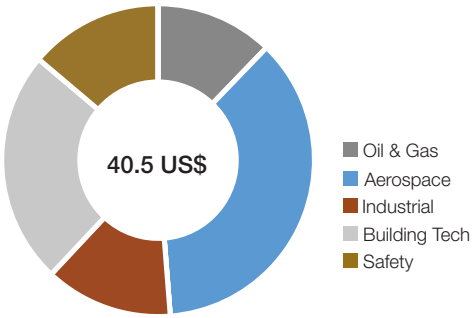
Company weaknesses

- Ranks fourth in transition risks, with only partial disclosure of Scope 3 emissions and the highest estimated Scope 3 intensity. It has the highest Scope 1+2 and energy intensities, though these have come down steeply over the period.
- Has the third-lowest quality of emissions reduction targets, and its disclosure on supplier engagement is relatively poor.
- Scores third-last in our patent analysis.

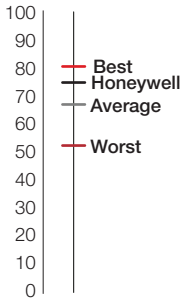
S3 Intensity & Disclosure weighted rank



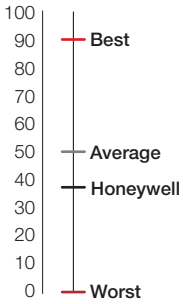
Revenue split by division



Low-carbon Product Score



Emission Reduction Targets Score



Siemens

Average market cap 2017: US$ 116.2 bn

Country: Germany

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
SIE GR	2	3	1	2

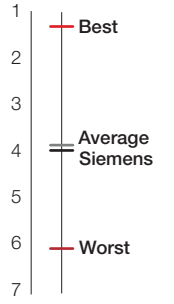
Company strengths

- Third most exposed business mix to growth markets, with >50% revenues from renewables, T&D, building techs and industrial digitalization/automation.
- Ranks first in our top-10 products analysis, with the most transformative product suite. This includes energy storage and renewable technologies, IoT platforms, electromobility and ultra HVDC technologies.
- Ranks 2nd-best in governance, with good level of product LCA and supplier engagement. It has the 3rd-best emissions reduction targets and climate risk management.

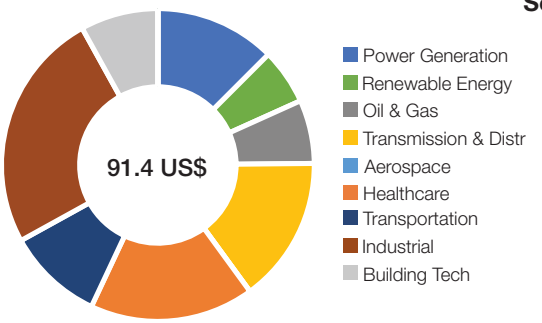
Company weaknesses

- Provides only partial disclosure of S3 emissions, with no disclosure of Use of Sold Goods products category.
- It ranks 4th on business resilience, with below average EBITDA margins and above average exposure to long-cycle capex.
- It doesn't disclose details about climate-related remuneration at any level.

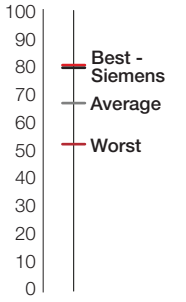
S3 Intensity & Disclosure weighted rank



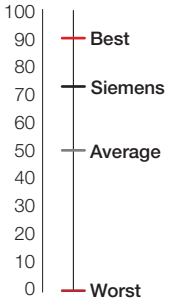
Industrial revenue split by division



Low-carbon Product Score



Emission Reduction Targets Score



Vestas

Average market cap 2017: US$ 16.8 bn

Country: Denmark

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
VWS DC	1	1	2	1

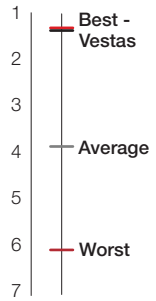
Company strengths

- Leads on exposure to growth markets, with 100% of the business in renewables. It ranks third in our top-10 product analysis (products including hybrid renewables, energy storage and wind farm digitalization) and first in our patent analysis.
- Ranks first in governance, with the best climate-related board expertise and risk management, the best supplier engagement, and second-best CO_2 reduction target (including a S3 target).
- Has the best S3 disclosure and intensity, the best S1+2 and energy intensities (both level and trend).

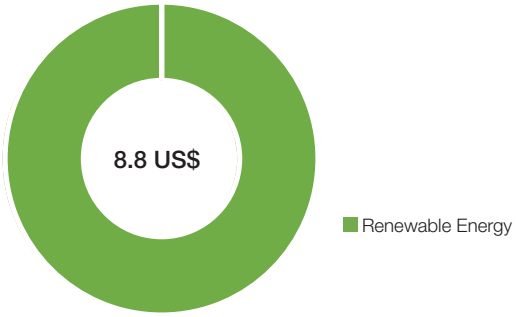
Company weaknesses

- Rank lowest in R&D intensity, at 2.4%.
- Doesn't disclose any climate-related remuneration across the company.

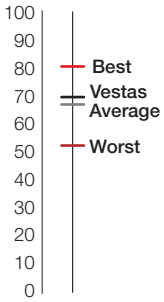
S3 Intensity & Disclosure weighted rank



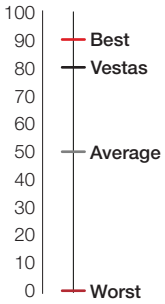
Revenue split by division



Low-carbon Product Score



Emission Reduction Targets Score



Heavy Machinery

PACCAR

Average market cap 2017: US$ 24.1 bn

Country: USA

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
PCAR US	7	5	7	7

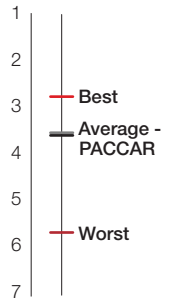
Company strengths

- Demonstrates advanced level of Scope 3 disclosure. The company reports on Use of Sold Products, Purchased Goods and Services as well as 12 of the 15 other Scope 3 categories.
- Has the lowest operating energy intensity and has reduced its intensity by 6.2% p.a. between 2012-2016.
- The company has set a Scope 3 emissions reduction target relating to the Use of Sold Products and engages with 83% of its supplier on climate related issues.

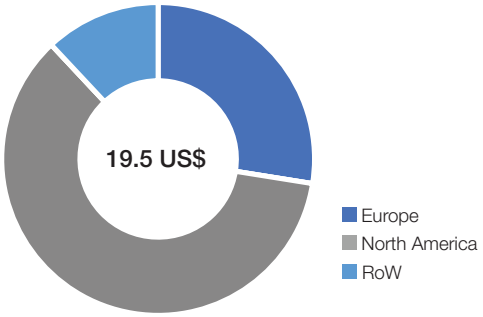
Company weaknesses

- Ranks last overall, despite demonstrating good levels of disclosure. Ranks last in transition risks and climate governance and strategy.
- PACCAR rank last across all three sub-sectors of the low-carbon product scorecard. It has a limited range of electric trucks and more than 50% of the top 10 low-carbon products were considered to be incremental.
- Has the second highest Scope 3 emissions intensity.
- The company ranks last in climate governance for the Heavy Machinery subsector, however still demonstrates relatively advanced levels compared with other sub-sectors.

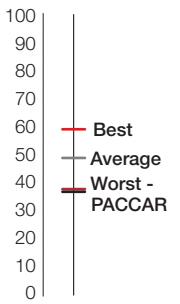
S3 Intensity & Disclosure weighted rank



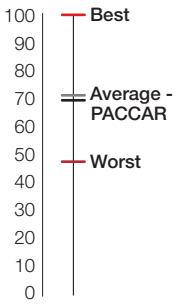
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Komatsu

Average market cap 2017: US$ 30.8 bn

Country: Japan

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
6301 JP	5	3	6	1

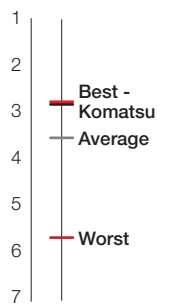
Company strengths

- Ranks in the top three for transition risks. The company has reduced its manufacturing emissions by 6.4% p.a. and energy intensity by 3.3% p.a. It also discloses on all but one of the most important Scope 3 categories and has a relatively low Scope 3 emissions intensity.
- Ranks first in climate governance and strategy. The company has a Scope 3 emissions target relating to the Use of Sold Products that has been verified by the SBTI, the only company across the whole report to have done so. It also performs well in Board-level climate management.
- The company has the second highest R&D expenditure as a % of sales.

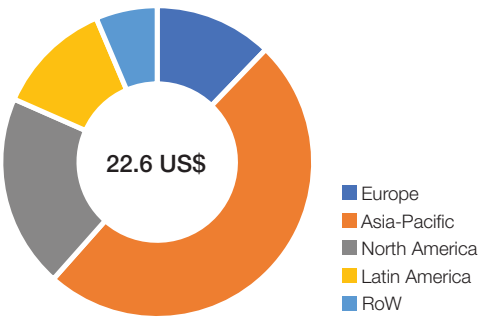
Company weaknesses

- Komatsu ranks second last in terms of the low-carbon product scorecard with only a limited range of electrified products. 60% of Komatsu's top 10 low-carbon products were considered to be incremental.
- Products are limited to partial automation of machinery and fuel efficiency measures, with the only product seen to be transitional relating to Komatsu's KOMTRAX tracking system.
- Despite revenue exposure to a number of different regions the company is seen to be less resilient, with its portfolio limited to mining and construction machinery, compared to companies across different end-markets.

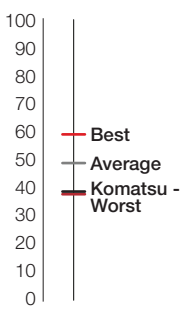
S3 Intensity & Disclosure weighted rank



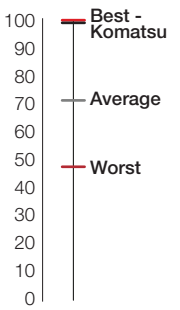
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Hino Motors

Average market cap 2017: US$ 7.0 bn

Country: Japan

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
7205 JP	5	4	5	4

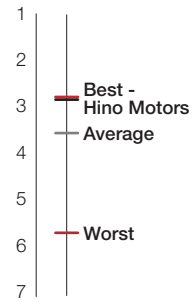
Company strengths

- Shows advanced levels of Scope 3 disclosure, reporting on 12 of the 15 categories including Use of Sold Products, Purchased Goods and Services. Scope 3 intensity is amongst the lowest.
- Has reduced its Scope 1 + 2 emissions the most, in line with its ambitious "Environmental Challenge 2050" to reach zero emissions in its manufacturing by 2050.
- Has a Scope 3 target to reduce Scope 3 emissions by 90% by 2050.

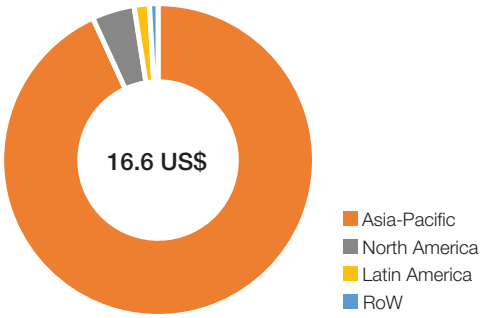
Company weaknesses

- Hino has the most limited range of low-carbon products and ranks third last in terms of the low-carbon product score. 40% of Hino's top 10 low-carbon products were considered to be incremental. This is at odds with the goals set out in its "Environmental Challenge 2050". However, it's R&D as a % of sales has increased the most from 2012-2017.
- Has the second lowest EBITDA margins in the subsector
- Reporting of energy intensities is limited, and we were unable to produce and trend for the company.

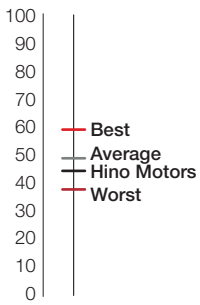
S3 Intensity & Disclosure weighted rank



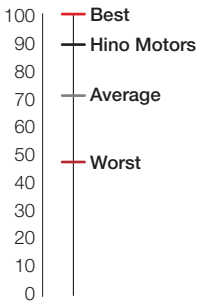
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Deere & Company

Average market cap 2017: US$ 45.5 bn

Country: USA

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
DE US	4	6	4	3

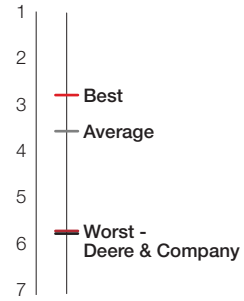
Company strengths

- Resilient to transition risks with highest EBITDA margins and good exposure to North and Latin American agricultural markets.
- Deere has the most diversified and largest portfolio of low-carbon products relating to electrification and precision agriculture.
- Has the greatest R&D expenditure as a % of sales at 4.3% p.a. and expenditure has been increasing since 2012.
- The company has two board members with varying levels of climate competency and remuneration relating to performance relative to energy or GHG targets.

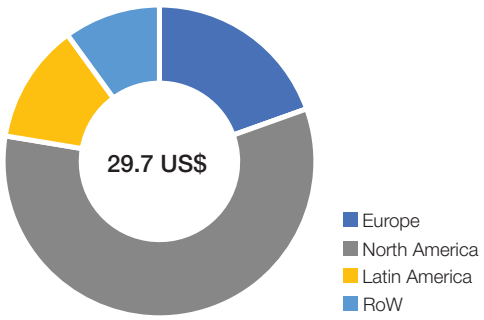
Company weaknesses

- Does not disclose on the two most important Scope 3 classification. The only responding company not to do so within the subsector.
- The company has a relatively high manufacturing emissions and energy intensity that have increased over time.
- Deere currently does not have an emissions reduction target relating to Scope 3. It's Scope 1+2 intensity target is also the weakest within the subsector and will expire in 2018.

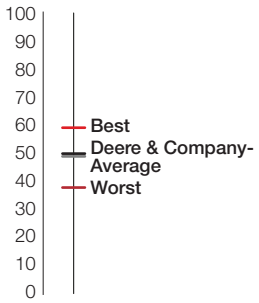
S3 Intensity & Disclosure weighted rank



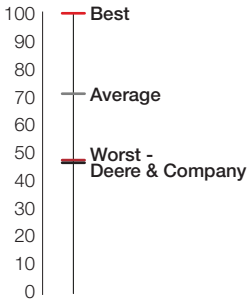
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Hitachi Construction Machinery

Average market cap 2017: US$ 7.2 bn

Country: Japan

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
6305 JP	3	7	2	6

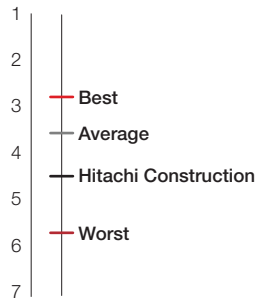
Company strengths

- Hitachi come second overall in transition opportunities, the highest weighted metric.
- The company comes third in terms of its low-carbon product score with a number of electric construction and mining vehicles and vehicle management systems. 40% of Hitachi's products were considered to be transformative and 40% radical.
- Hitachi was ranked in first position for the total number of patents filed (per 10,000 employees) with 56% focusing on technologies that relate to the electrification of construction and mining machinery.
- Ranks first for Scope 1+2 emissions intensity.

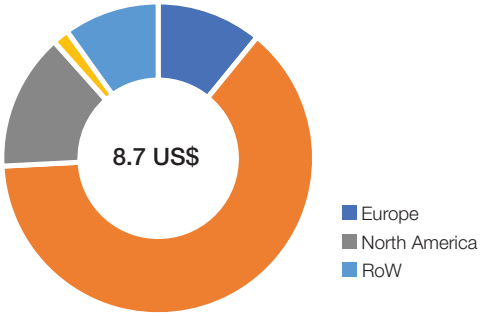
Company weaknesses

- Despite having the highest Scope 3 emissions intensity, we note that Hitachi have been consistently reporting on Scope 3 since 2011 and therefore its intensity may reflect improvements in its Use of Sold Products accounting methodology.
- Has the lowest EBITDA margins across the subsector and is within the bottom three in terms of exposure to high growth markets.
- Performs poorly overall in climate governance and strategy. The shows limited evidence of conducting life-cycle analysis of tis products and engages with 40% of it's suppliers.

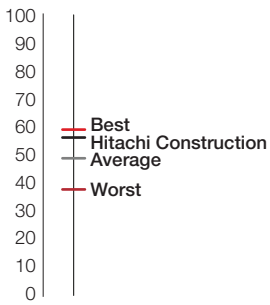
S3 Intensity & Disclosure weighted rank



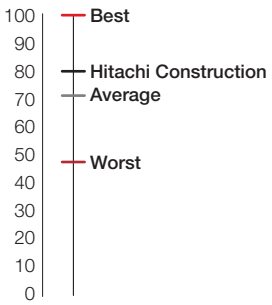
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



Kubota

Average market cap 2017: US$ 22.3 bn

Country: Japan

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
6326 JP	2	1	1	5

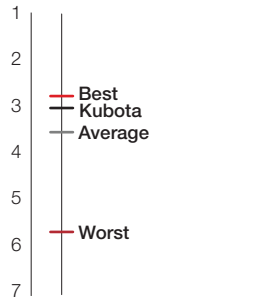
Company strengths

- Ranks second overall and ranks first in transition risks and opportunities.
- Kubota comes second in terms of its low-carbon product score with a number of electric farm machines and precision agricultural platforms. 70% of Kubota's top 10 low-carbon products were considered to be transformative or radical in a range of end markets including agriculture, industry and buildings.
- Kubota performs well in the two highest weighted metrics – Scope 3 intensity and disclosure and business resilience. The company is resilient, operating across multiple end-markets within several geographies. It also has high EBITDA margins.
- The company has high R&D expenditure as a % of sales and scores well in the patent analysis.

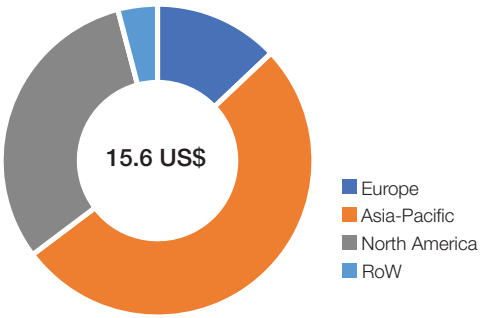
Company weaknesses

- Going forward, the company will need to do more to reduce its Scope 1 + 2 emissions intensity and energy intensity in its manufacturing processes.
- It currently has the highest energy intensity that has increased over time.
- The company currently does not have an emissions reduction target relating to Scope 3. Furthermore, it's Scope 1+2 target is not ambitious – aiming for a 30% reduction by 2030.

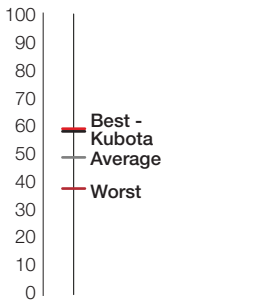
S3 Intensity & Disclosure weighted rank



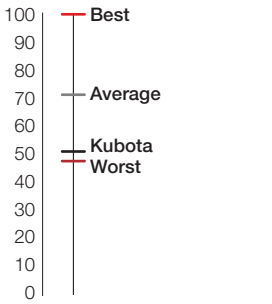
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



CNHI

Average market cap 2017: US$ 17.1 bn

Country: USA

Ticker	League Table rank	Transition risks rank	Transition opportunities rank	Climate governance & strategy rank
CNHI US	1	2	3	2

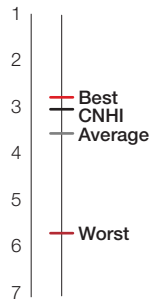
Company strengths

- CNHI rank first overall, coming in the top three across transition risks, opportunities and climate governance
- The company has good Scope 3 disclosure, and low emissions intensities across all scopes. With its diverse range of products across multiple end-market and geographies it is also resilient.
- Leads the sub-sector in terms of their low-carbon product score with a range of electric machinery products and advanced automation pilots. 100% of the top 10 CNHI low-carbon products were considered to be either transformative or radical.
- Ranks second in climate governance and strategy with good supplier engagement and remuneration relating targets for its energy/ sustainability managers in relation to energy consumption and GHG emissions reductions.

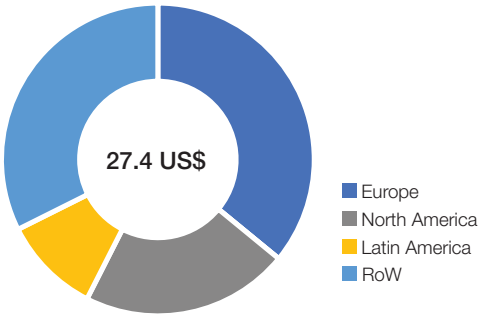
Company weaknesses

- The company's Scope 1+2 emissions have increased by 3& p.a. from 2012-2016.
- Has limited numbers of patents filed in relation to electrification and fuel and connectivity compared to its competitors.
- The company currently does not have an emissions reduction target relating to Scope 3 and its Scope 1+2 target only aims to reduce emissions by 17% by 2022. However, the company is committed to setting a Science Based Target.

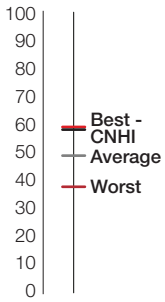
S3 Intensity & Disclosure weighted rank



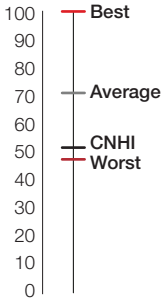
Revenue split by region



Low-carbon Product Score



Emission Reduction Targets Score



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