# US technology sector

## CES 2023 – Expanding AI applications

**Dow Jones Industrial Average**
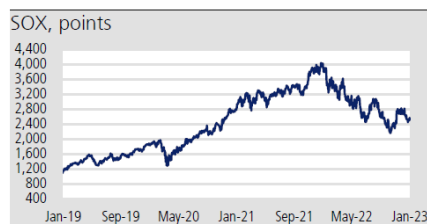
DJIA, points
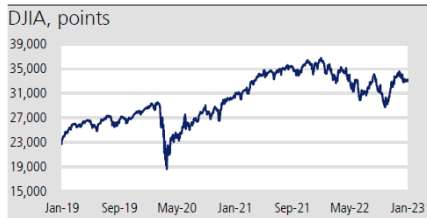


*Source: Bloomberg*

**Nasdaq**

Nasdaq, points
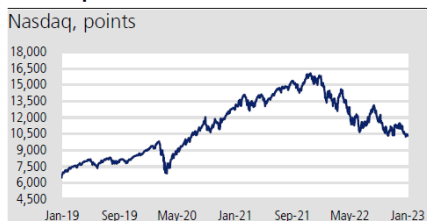


*Source: Bloomberg*

**SOX**

SOX, points



*Source: Bloomberg*

**ESG score card**

| Company | | Overall | E | S | G |
|---|---|---|---|---|---|
| Qualcomm | QCOM US | 69 | 68 | 88 | 41 |
| AMD | AMD US | 70 | 70 | 76 | 60 |
| NVIDIA | NVDA US | 79 | 69 | 83 | 86 |

*Source: Refinitiv; Company data*

### Event

Hot topics for 2023 CES include smart mobility (electric vehicles and autonomous driving) and diversified investment in AI across varied edge applications, including consumer electronics, smart home, transportation, healthcare, industrial manufacturing, and robotic automation. However, we believe downward earnings revisions and high inventory levels are the two major risks in the near term.

### Impact

**Active implementation of AI platforms.** Main highlights include: (1) the major OEMs are increasing leverage of AI to create smooth and connected experiences between the driver and vehicle, as well as implementing personal AI to synchronize all aspects of the driver's digital lifestyle (i.e. Nvidia (US), Mobileye (US), Qualcomm (US)); (2) CSPs are helping the transportation supply chain build their own digital platforms by providing cloud and edge technologies (i.e. Microsoft (US)); and (3) personal AI for smart home applications (i.e. Samsung (KR)).

**AI chip market 2023-26F revenue CAGR of 16%.** Gartner estimates the AI chip market will reach US$86bn in 2026, which is 2.9x that of 2020, for a 2023-26F revenue CAGR of 16%. AMD (US) disclosed its new XDNA architecture, which includes AI technology that the company purchased from Xilinx (US), at the beginning of its CES keynote. Ryzen AI will be used in its Ryzen Mobile 7040 series (Phoenix) which is based on Zen4 and RDNA3. Other chip announcements (Figures 3, 4, and 6) include: (1) AMD's first chiplet-based Ryzen 7045X (Zen4+RDNA2) and Radeon RX 7000 series (RDNA3) for NBs, and Ryzen 7000X3D processors (with Zen4 3D V-cache for better gaming performance) for DTs; (2) Nvidia's RTX40 series (Ada Lovelace) for gaming NBs and RTX 4070i (RTX 4080 12G rebranding) for DT; and (3) Intel (US)'s Raptor Lake (Intel 7) on a wide range of NBs, including the first 24-core CPU.

**EPS revision is near-term risk.** In addition to weak consumption of personal electronics during this past holiday season (US retail sales fell 5% YoY, versus 4% growth expected by Mastercard (US)), we see downside risk for automotive and servers. Meta's (US) cancellation of data center projects and automotive executives weak confidence in EV adoption indicate a cloudy outlook for 1Q23. As such, we expect downward EPS revisions in the following weeks. For Nvidia and AMD specifically, we think channel inventory of gaming GPUs is approaching a normal level as pricing stabilizes, but demand might take time to recover. Our 4Q22-1Q23 EPS estimate for Nvidia is a respective 3% and 18% below consensus, while that for AMD is 10% and 9% below (Figure 5).

**Figure 1: Performance of major stock indices**

| Index | Recent close (pts) | 1W (change, %) | 2W | 1M | 3M | 6M | 12M | YTD |
|---|---|---|---|---|---|---|---|---|
| Dow Jones | 32,930 | (0.9) | (0.3) | (3.0) | 8.8 | 6.3 | (9.6) | (0.7) |
| Nasdaq | 10,305 | (1.6) | (1.6) | (8.3) | (7.6) | (9.0) | (31.8) | (1.5) |
| SOX | 2,519 | (0.6) | (0.6) | (8.0) | (0.2) | 1.6 | (35.1) | (0.5) |

Source: Bloomberg

**Figure 3:  2023 CES new CPU announcements**

| Processors | Devices | | Entry-level ➝ High-end | | | | | |
|---|---|---|---|---|---|---|---|---|
| CPU | Notebook | Intel | 13th Gen Intel Core - Raptor Lake (Intel 7) | | | | | |
| | | Series | N-series | U-series | P-series | | H-series | HX-series |
| | | AMD | Ryzen™ 7000 Series Processors (TSMC 4/5/6/7nm) | | | | | |
| | | Series | | Ryzen 7030U-series (Zen 3, RDNA2, TSMC 7nm) | Ryzen 7035U-series (Zen 3+, RDNA2, TSMC 6nm) | Ryzen 7045HX-series (Zen 4, RDNA2, TSMC 5nm) Ryzen 7035HS-series (Zen 3+, RDNA2, TSMC 6nm) | | Ryzen 7040HS-series (Zen 4, XDNA AI, RDNA3, TSMC 4nm) |
| | Desktop | Intel | 13th Gen Intel Core - Raptor Lake (Intel 7) | | | | | |
| | | Series | | T-series 35W | | 13th Gen/F-series 65W | | K-series 125W (announced in Oct-22) |
| | | Recommended customer price (US$) | | 134-524 | | 109-549 | | 294-589 |
| | | AMD | Ryzen™ 7000 Series Processors (TSMC 5nm) | | | | | |
| | | Series | | | | Ryzen 7900/ 7700/ 7600 (Zen 4, TSMC 5nm) | | Ryzen 7950X3D/7900X3D/7800X3D (3D V-Cache, Zen 4, TSMC 5nm) |
| | | Recommended customer price (US$) | | | | 229/329/429 | | 449/549/799 |

Source:  Company data, KGI Research

**Figure 4: 2023 CES new GPU announcements**

| GPU | NVIDIA | AMD |
|---|---|---|
| Architecture | Ada Lovelace | RDNA3 |
| Process node | TSMC 4nm | TSMC 6nm |
| Notebook | RTX 4050/ 4060/ 4070/ 4080/ 4090 | RX 7600S/ 7700S/ 7600M/ 7600M XT |
| Desktop | RTX 4070 Ti (US$ 799, RTX 4080 12G rebranding) | X |

Source: Company data; KGI Research

**Figure 5: KGI EPS estimates vs. consensus**

| EPS (US$) | KGI | | vs. Consensus (%) | |
|---|---|---|---|---|
| | 4Q22 | 1Q23 | 4Q22 | 1Q23 |
| NVIDIA | 0.78 | 0.72 | (3) | (18) |
| QoQ (%) | 34 | (7) | | |
| YoY (%) | (41) | (47) | | |
| AMD | 0.61 | 0.65 | (10) | (9) |
| QoQ (%) | (10) | 6 | | |
| YoY (%) | (34) | (43) | | |

Source: Company data; Bloomberg; KGI Research

**Figure 6:  Chip roadmap**

| | | 1Q21 | 2Q21 | 3Q21 | 4Q21 | 1Q22 | 2Q22 | 3Q22 | 4Q22 | 1Q23F | 2Q23F | 3Q23F | 4Q23F | 1Q24F | 2Q24F | 3Q24F | 4Q24F | 2025F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CPU** | **Intel** | | | | | | | | | | | | | | | | | |
| | NB | 14nm+++ Rocket Lake | | Intel 7 Alder Lake | | | | | Intel 7 Raptor Lake | | | | | Intel 4 Meteor Lake | | | | N3 (TSMC) and Intel 20A Arrow Lake |
| | Desktop | 14nm+++ Rocket Lake | | Intel 7 Alder Lake | | | | Intel 7 Raptor Lake | | | | | | Intel 4 Meteor Lake | | | N3 (TSMC) and Intel 20A Arrow Lake | |
| | Server | 10nm+ Ice Lake-SP | | | | | | | Intel 7 Sapphire Rapids (re-tape out) Intel 7 Sapphire Rapids HBM in 4Q22 | | Intel 7 Emerald Rapids | | | Intel 3 Granite Rapids (P-core) Intel 3 Sierra Forest (E-core) | | | | |
| | **AMD** | | | | | | | | | | | | | | | | | |
| | NB | N7+ (TSMC) Cezanne (Zen 3) | | | N6 (TSMC) Rembrandt (Zen 3+) | | | N4 (TSMC) Phoenix (Zen 4), N5 (TSMC) Dragon Range (Zen 4) | | | | | | N4/3 (TSMC) Strix Point (Zen 5) | | | | |
| | Desktop | N7 (TSMC) Vermeer (Zen 3) | | | | | N5 (TSMC) Raphael (Zen 4) | | | | | | | N4/3 (TSMC) Granite Ridge (Zen 5) | | | | |
| | Server | N7+ (TSMC) Milan (Zen 3) | | | | | N5 (TSMC) Genoa (Zen 4) N5 (TSMC) Bergamo (Zen 4C) in 1H23 | | | | | | | N4/3 (TSMC) Turin (Zen 5) | | | | |
| | **Nvidia** | | | | | | | | | | | | | | | | | |
| | Server | | | | | | | | | 5nm (TSMC) Grace | | | | | | | Grace Next | |
| **GPU** | **Intel** | | | | | | | | | | | | | | | | | |
| | PC | Intel 10nm SF Iris Xe MAX | | | | N6 (TSMC) Arc Alchemist NB in 1Q22; DT/Workstation in 4Q22 | | | | | | Battlemage | | | | Celestial | | |
| | Server | Intel 10nm SF Xe-LP | | | | N5/6/7 (TSMC) & Intel 7 Ponte Vecchio Intel 10 Arctic Sound-M in 3Q22 | | | | | | Rialto Bridge; Intel 20A Falcon Shores (XPU) Next Arctic Sound in 4Q23 | | | | | | |
| | **AMD** | | | | | | | | | | | | | | | | | |
| | PC | N7+ (TSMC) Big Navi (RDNA2) | | | | N5 (TSMC) Navi 3x RDNA3 | | | | | | N4/3(TSMC) Navi 4x RDNA4 | | | | | | |
| | Server | N7+ (TSMC) Arcturus (CDNA) | | | N6 (TSMC) Aldebaran (CDNA2) | | | | | N5 (TSMC) Instinct MI300  (CDNA3) | | | | | | | | |
| | **Nvidia** | | | | | | | | | | | | | | | | | |
| | PC | 8nm (SEC) Ampere | | | | N4 (TSMC) Ada Lovelace | | | | | | Blackwell (?) | | | | | | |
| | Server | N7 (TSMC) Ampere (A100) | | | | N4 (TSMC) Hopper | | | | | | Blackwell (?) | | | | | | |

Source:  Company data, KGI Research

**Figure 7: Discrete GPU market share**
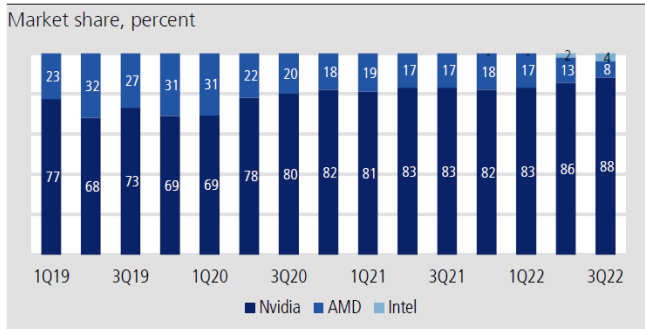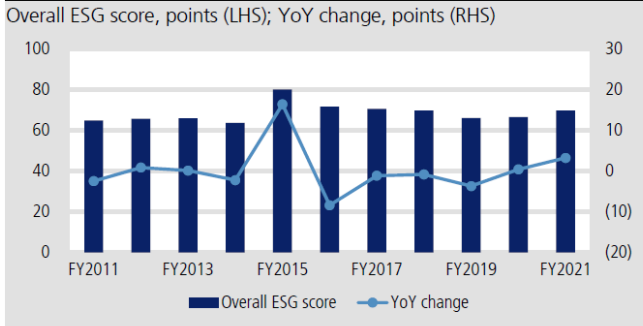


Source : Jon Peddie Research, KGI Research

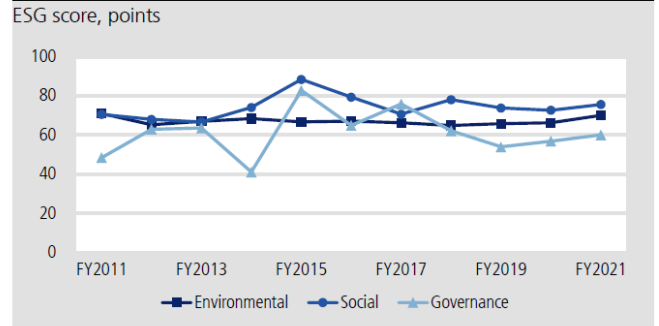**Figure 8: CPU market share - NB**
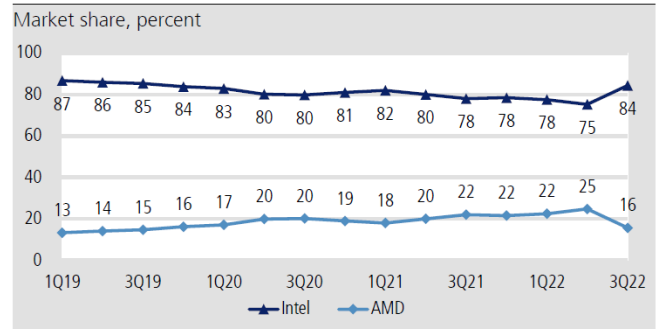


Source:  Mercury, KGI Research
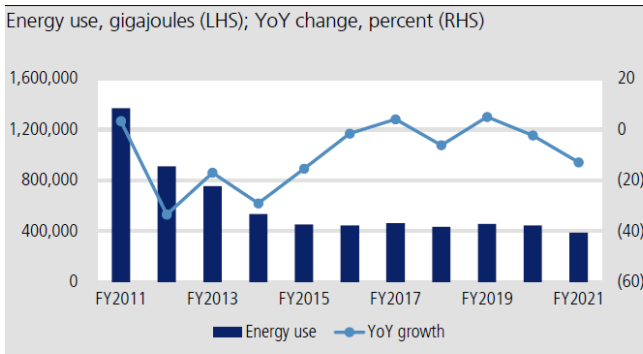
## AMD (AMD US)

**Figure 9: AMD – Overall ESG score**

Overall ESG score, points (LHS); YoY change, points (RHS)

Source: Refinitiv; Company data

**Figure 10: AMD – ESG score by category**

ESG score, points

Source: Refinitiv; Company data

**Figure 11: AMD – Energy use**

Energy use, gigajoules (LHS); YoY change, percent (RHS)

Source: Refinitiv; Company data

**Figure 12: AMD – Renewable energy**

Renewable energy purchased, gigajoules (LHS); renewable energy use ratio, percent (RHS)
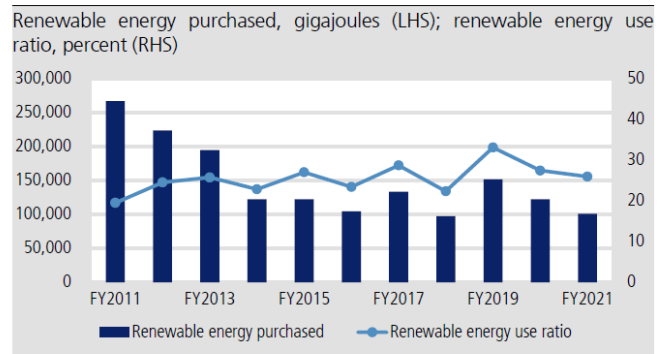
Source: Refinitiv; Company data

**Figure 13: AMD – CO2 equivalent emissions**

CO2 equivalent emissions, mt (LHS); emissions to revenue, mt/ US$mn (RHS)
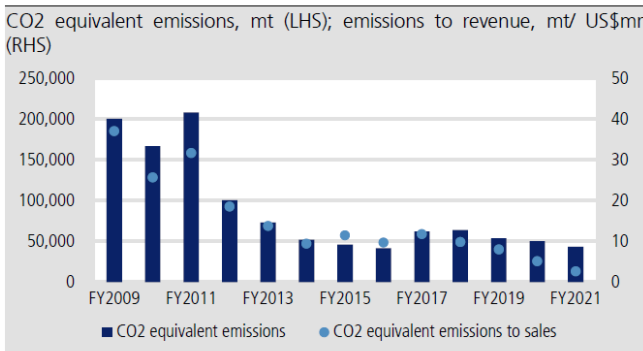
Source: Refinitiv; Company data

**Figure 14: AMD – Waste total**

Waste total, mt (LHS); waste recycling ratio, percent (RHS)
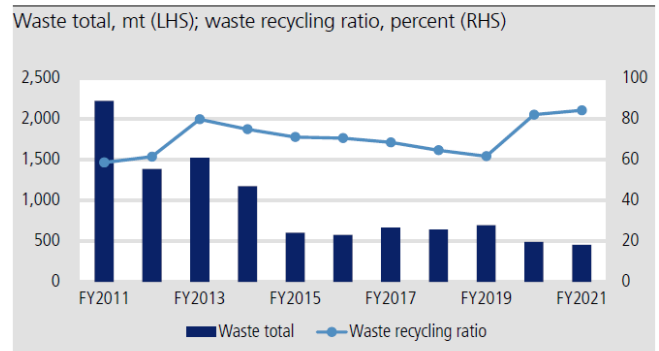
Source: Refinitiv; Company data

**Figure 15: AMD – Water use to revenue**

Water use to revenue, m3/ US$mn (LHS); YoY change, percent (RHS)
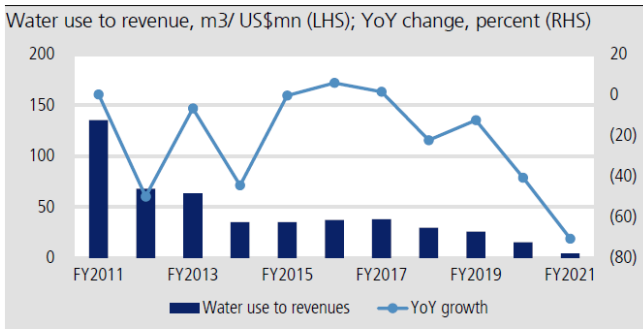
Source: Refinitiv; Company data

**Figure 16: AMD – Gender diversification**

Weighting of female managers & employees, percent
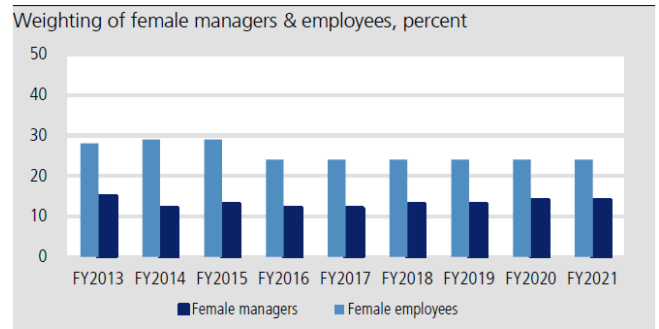
Source: Refinitiv; Company data

**Nvidia (NVDA US)**

**Figure 17: Nvidia – Overall ESG score**

Overall ESG score, points (LHS); YoY change, points (RHS)



Source: Refinitiv; Company data
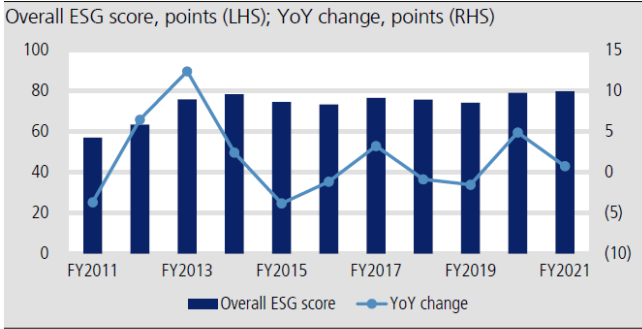
**Figure 18: Nvidia – ESG score by category**

ESG score, points



Source: Refinitiv; Company data
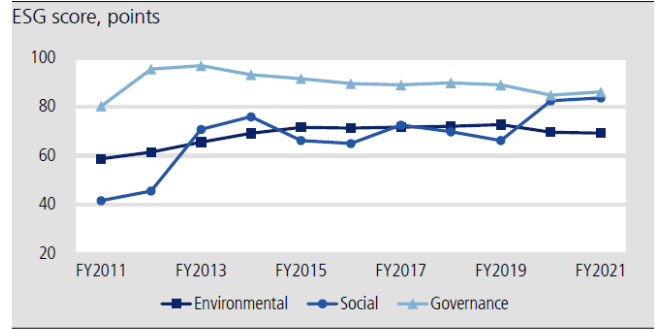
**Figure 19: Nvidia – Energy use**

Energy use, gigajoules (LHS); YoY change, percent (RHS)



Source: Refinitiv; Company data
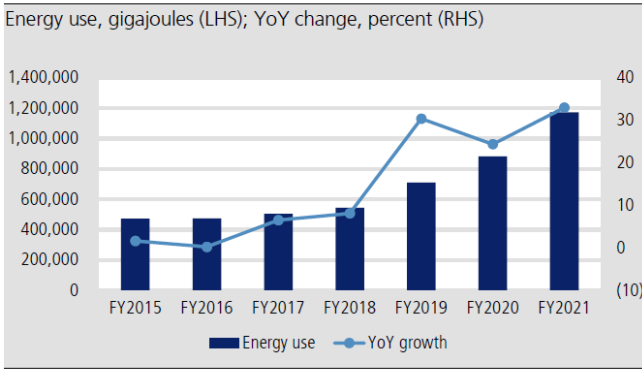
**Figure 20: Nvidia – Renewable energy**

Renewable energy purchased, gigajoules (LHS); renewable energy use ratio, percent (RHS)



Source: Refinitiv; Company data
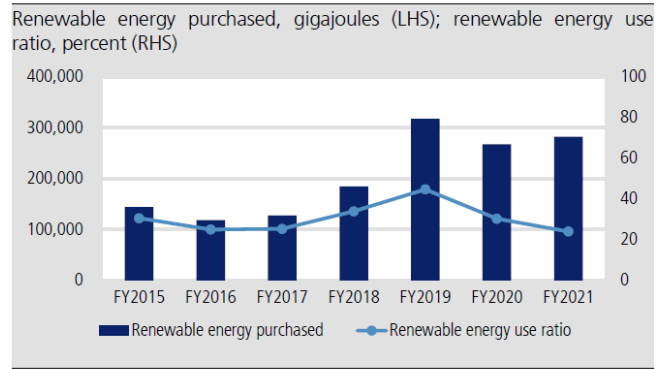
**Figure 21: Nvidia – CO2 equivalent emissions**

CO2 equivalent emissions, mt (LHS); emissions to sales, mt/ US$mn (RHS)



Source: Refinitiv; Company data
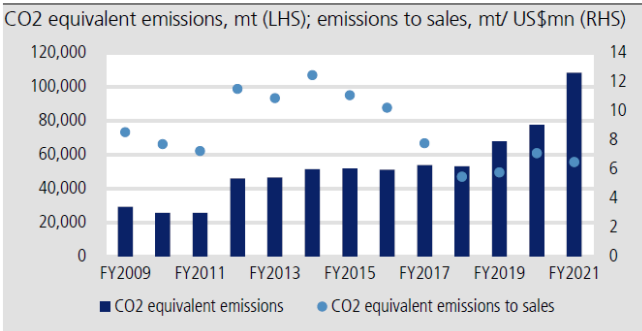
**Figure 22: Nvidia – Waste total**

Waste total, mt (LHS); waste recycling ratio, percent (RHS)



Source: Refinitiv; Company data
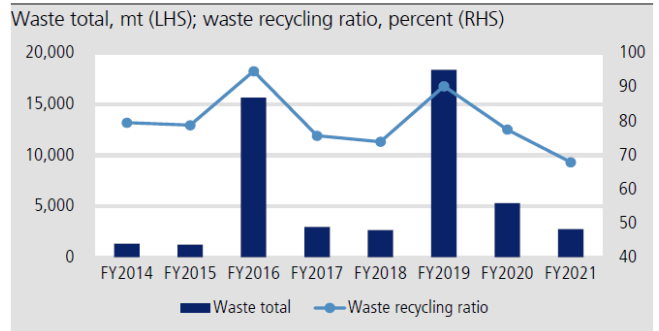
**Figure 23: Nvidia – Water use to revenue**

Water use to revenue, m3/ US$mn (LHS); YoY change, percent (RHS)



Source: Refinitiv; Company data
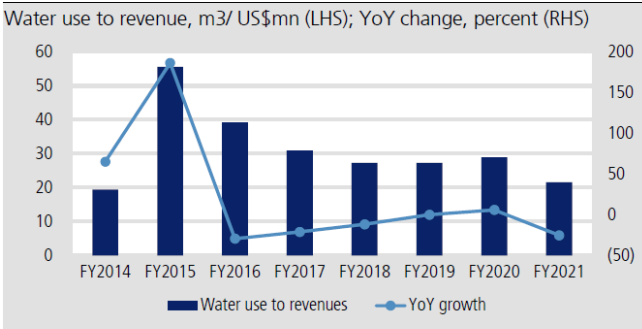
**Figure 24: Nvidia – Gender diversification**

Weighting of female managers & employees, percent



Source: Refinitiv; Company data
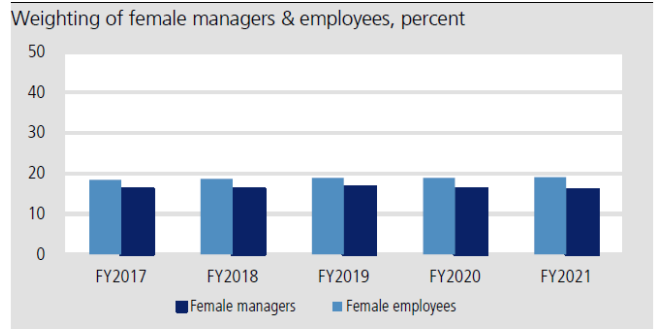
## Qualcomm (QCOM US)

**Figure 25: Qualcomm – Overall ESG score**

Overall ESG score, points (LHS); YoY change, points (RHS)
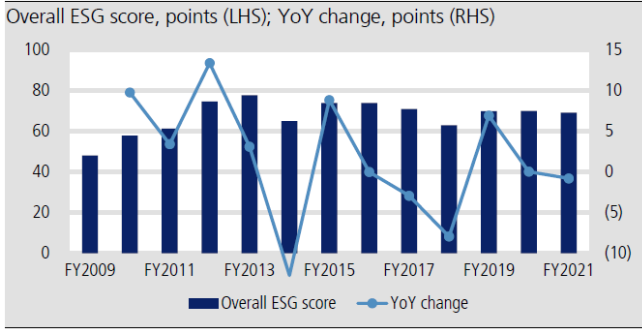


*Source: Refinitiv; Company data*

**Figure 26: Qualcomm – ESG score by category**

ESG score, points
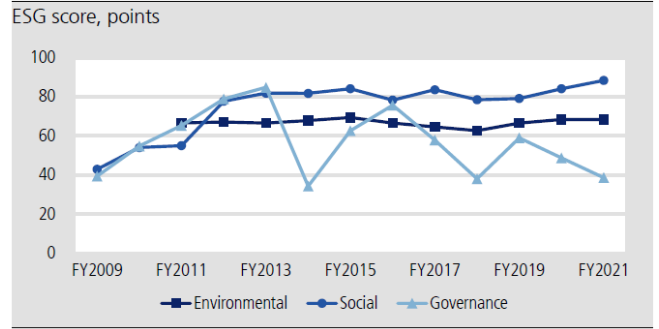


*Source: Refinitiv; Company data*

**Figure 27: Qualcomm – CO2 equivalent emissions**

CO2 equivalent emissions, mt (LHS); emissions to sales, mt/ US$mn (RHS)
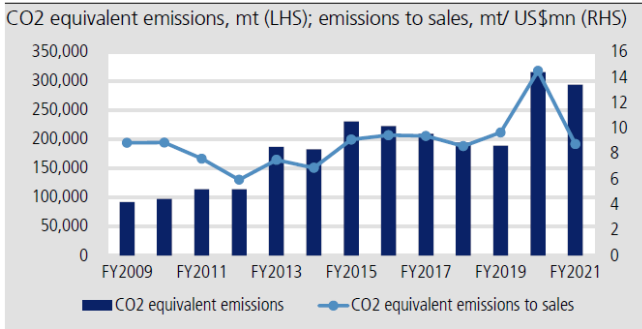


*Source: Refinitiv; Company data*

**Figure 28: Qualcomm – Waste total**

Waste total, mt (LHS); waste recycling ratio, percent (RHS)
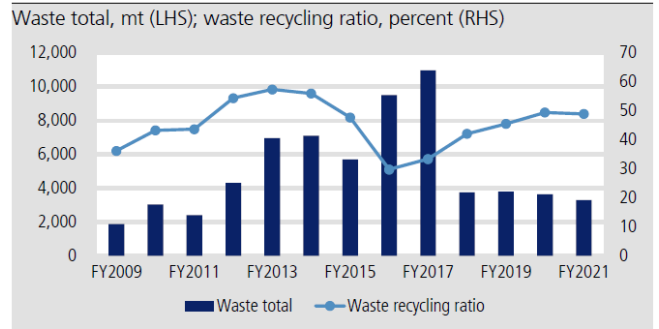


*Source: Refinitiv; Company data*

**Figure 29: Qualcomm – Water use to revenue**

Water use to revenue, m3/ US$mn (LHS); YoY change, percent (RHS)
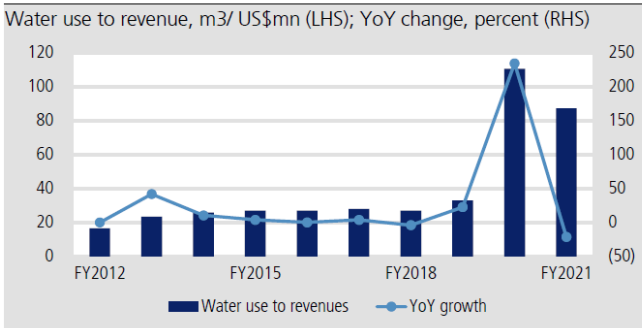


*Source: Refinitiv; Company data*

**Figure 30: Qualcomm – Employee turnover**

Employee turnover, percent
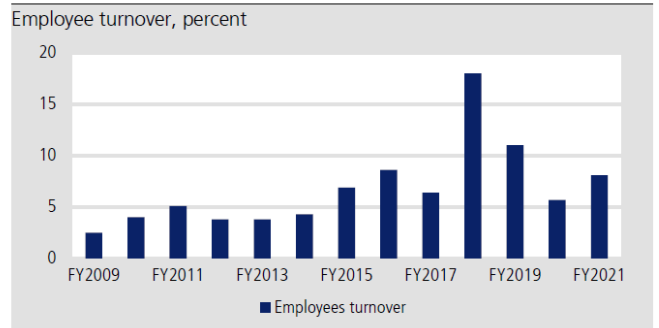


*Source: Refinitiv; Company data*

**Figure 31: Qualcomm – Gender diversification**

Weighting of female managers & employees, percent
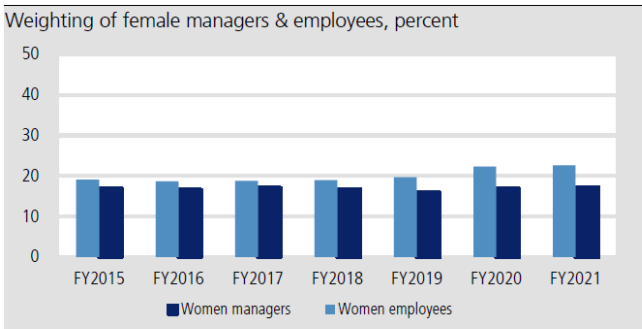


*Source: Refinitiv; Company data*

**Figure 32: Qualcomm – Independent board members**

Weighting of independent board members, percent
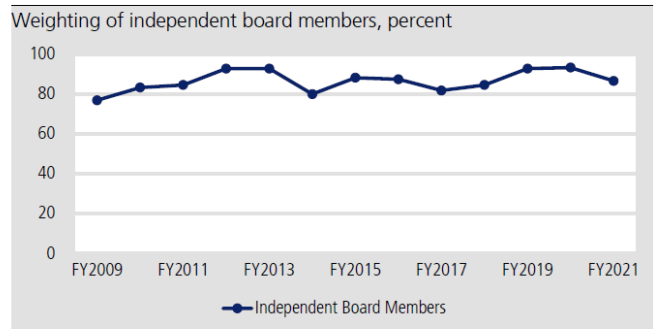


*Source: Refinitiv; Company data*

| Item | Definition |
|---|---|
| Energy use | Total direct and indirect energy consumption in gigajoules.<br>- the total amount of energy that has been consumed within the boundaries of the company's operations<br>- total energy use = total direct energy consumption + indirect energy consumption<br>- purchased energy and produced energy are included in total energy use<br>- for utilities, transmission/ grid loss as part of its business activities is considered as total energy consumed and data does not consider electricity produced to answer energy use (utility company produces to sell)<br>- for utilities, raw materials such as coal, gas or nuclear used in the production of energy are not considered under 'total energy use' |
| Renewable energy purchased | Total primary renewable energy purchased in gigajoules.<br>- energy consumed by the company from various sources and among the purchased energy, how much energy is renewable in nature (solar, wind, hydro, biomass, geothermal) are in scope<br>- if there is no evidence that renewable energy is produced by the company, then we consider the reported energy figure as renewable energy purchased |
| Renewable energy use ratio | Renewable energy to total energy used |
| CO2 equivalent emissions | Direct CO2 and CO2 equivalent emissions in metric tons.<br>- direct emissions from sources that are owned or controlled by the company (scope 1 emissions)<br>- following gases are relevant: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCS), perfluorinated compound (PFCS), sulfur hexafluoride (SF6), nitrogen trifluoride (NF3) |
| CO2 equivalent emissions to sales | Direct CO2 and CO2 equivalent emissions (metric tons) to sales (NT$mn)<br>- direct emissions from sources that are owned or controlled by the company (scope 1 emissions)<br>- following gases are relevant: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCS), perfluorinated compound (PFCS), sulfur hexafluoride (SF6), nitrogen trifluoride (NF3) |
| Waste total | Total amount of waste produced in metric tons.<br>- total waste = non-hazardous waste + hazardous waste<br>- only solid waste is taken into consideration, exceptionally if liquid waste is reported in metric tons, then we do the summation to derive total including liquid waste<br>- for sectors like mining, oil & gas, waste generation like tailings, waste rock, coal and fly ash are also considered |
| Waste recycling ratio | The waste recycling ratio as reported by the company.<br>- waste recycling ratio = waste recycled/total waste*100<br>- waste to energy or waste incinerated with energy recovery are considered as waste recycled<br>- waste recovered via composting is considered as recycled waste |
| Water withdrawal total | Total water withdrawal in cubic meters.<br>- the total volume of water withdrawn from any water source that was either withdrawn directly by the reporting organization or through intermediaries such as water utilities<br>- different sources of water like wells, town/utility/municipal water, river water, and surface water are considered |
| Environmental expenditures | Total amount of environmental expenditures.<br>- all environmental investment & expenditures for environmental protection or to prevent, reduce, control environmental aspects, impacts, and hazards. It also includes disposal, treatment, sanitation, and clean-up expenditures |
| Turnover of employees | Percentage of employee turnover.<br>- includes employees who left the company for any reason (voluntary or involuntary), such as resignations, retirement, natural departure/death, medical incapacitation, redundancy, layoffs, restructuring, dismissal, retrenchment or end of a fixed-term contract<br>- employees turnover rate = (employees leaving/average number of employees)*100<br>- where the average number of employees = (employees at the end of the current year + employees at the end of the previous year)/2<br>- employees at the end of the current fiscal year = employees at the end of the previous fiscal year + new employees - employees leaving |
| Women managers | Percentage of women managers.<br>- percentage of women managers among total managers of the company<br>- if there is a breakdown by category in percentage, such as top, senior, middle, and junior management, then we consider the percentage of middle women managers<br>- percentage of women managers = number of women managers/total number of managers*100 |
| Women employees | Percentage of women employees.<br>- percentage of women employees to the total number of employees of the company<br>- percentage of women employees = number of women/total number of employees*100 |
| Training hours total | Total training hours performed by all employees.<br>- consider only employee training hours<br>- includes all types of training given to general employees (such as health & safety, environmental, emergency response, skills & career development training)<br>- if the value is given in days, multiply by 8, assuming that 1 day = 8 hours worked |
| Training hours per employee | Training hours per employee per year |

**All the above named KGI analyst(s) is SFC licensed person accredited to KGI Asia Ltd to carry on the relevant regulated activities. Each of them and/or his/her associate(s) does not have any financial interest in the respectively covered stock, issuer and/or new listing applicant.**