Risk-assessments for three categories of information technology

A report for Direktoratet for forvaltning og IKT (DIFI) by Rosie Sharpe

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Introduction

I have carried out risk-assessments on five products within two product categories (food and drink; IT equipment) on behalf of Direktoratet for forvaltning og IKT (DIFI). The risk assessments follow the same methodology[1] as the previous risk assessments carried out by Swedwatch on five product categories (furniture, medical supplies, office supplies, play and sports equipment, clothes and footwear). This introduction, including the section on methods and data, was written by Swedwatch.

The risk-assessments aim to provide information on potential adverse impacts on labour rights and human rights in the supply chains of the selected products. The reports will guide contracting authorities on the importance of social considerations in their purchasing practices and when such criteria should be applied. The risk-assessments will also improve the readers' understanding of what to look for when monitoring supplier compliance.

It is important to note that the risk-assessments do not aim to scrutinise or describe the supply chain of any particular brand or supplier. The purpose is to give a general understanding of the potential risks linked to the product in general.

Each product is described based on components and materials used in the product. The general supply chain is presented in a table, along with a narrative explanatory paragraph. Where appropriate, the supply chain table is divided into three sections: assembly or manufacture, components and raw materials or ingredients, and provides an overview of most relevant countries.

General risks are outlined and the most adverse risks for each step of the supply chain are summarised in an introductory table in order to provide an overview. The grading at the bottom of the risk-matrix indicates a combination of the *severity* and *likelihood* of the risk and aims to provide guidance on where main risks are located in the supply chain. For example, when a product is assembled in both a high-risk and a low-risk context to more or less the same extent, the risk will be graded lower than if the product had been predominantly assembled in a high-risk environment. This also means that even if a number of potential severe risks are listed in the column, the risk may still be considered low if it is likely that the production mostly takes place under safe and sound processes in a low-risk environment. Since the different IT products considered here contain many of the same components and raw materials, the human rights risks are often similar.

The risks are graded into the following categories:

Very low risk	Low risk	Medium-high risk	High risk	Very high risk

Method and data

The data used for the risk-assessments comes mainly from reports, articles, films and academic research. Trade data was used to map supply chains, as transparency and traceability is often limited. In the case of the risk assessments on furniture, medical supplies, office supplies, play and sports equipment and clothes and footwear (the risk assessments carried out by Swedwatch), suppliers, and to a smaller degree, industry organisations/initiatives, were also interviewed to help understand the supply chains. Therefore, the supply chain data, especially on a component and raw material level, presents the likelihood of a certain producing country being included in the supply chain. The supply

[1] Except that the Swedwatch risk assessments relied on trade data and, to a less extent, information from Norwegian companies, to map supply chains whereas these risk assessments rely on trade data only.

chain data can therefore not be viewed as exact for every single product procured by Norwegian contracting authorities, but as a general estimate.

This report was written March-April 2018 by Rosie Sharpe (independent consultant).

Information technology

Product	Assembly	Component	Raw material
Information technology	**Medium high risk**	**High risk**	**Very high risk**
Mobile phones	**Medium high risk**	**High risk**	**Very high risk**
Laptops	**Medium high risk**	**High risk**	**Very high risk**
Monitors	**Medium high risk**	**High risk**	**High risk**

The information technology sector relies heavily on factories in China and other Asian countries to assemble products and manufacture components. There are well-documented labour rights issues in these factories, particularly low pay, forced overtime, the abuse of student labour and the sacking of trade union leaders. Health and safety is an issue as the manufacture of electronics as it requires handling a large number of dangerous chemicals. There are widespread reports of the lack of personal protective gear and insufficient health and safety training. Workers are increasingly being employed on repeated short-term contracts and face extreme job insecurity. There has been considerable media attention on the labour rights conditions in the factories where big brand-name IT products are assembled, and, to a lesser degree, where the components are made. The human rights risks are therefore thought to be slightly lower for assembly than for the components.

A huge array of raw materials, particularly metals, are used in laptops, phones and monitors. They are sourced from mines all around the world, with China leading the list of source countries. Many of the metals come from artisanal or small-scale mines, where labour rights abuses are more common. Severe human rights breaches are documented in many mines including in some cases the use of child labour and forced labour. Mines in the Democratic Republic of Congo are linked with the funding of armed groups and tin mines in Myanmar are linked to the funding of the illegal drugs trade. Many of the mines are linked to severe environmental impacts and to highly dangerous working conditions.

Industry and sector Initiatives

Fairphone sells smartphones that are sourced from companies with better working conditions and that are easier to reuse and recycle. They aim to improve working conditions along their entire supply chain and to make their supply chain transparent.[2]

The **Responsible Mining Index** will measure the performance of mining companies on environmental, social and governance issues. The first index is expected to be published in 2018 and every two years after that.[3]

Voluntary codes of conduct

[2] Fairphone, Our goals, Accessed April 2018
[3] Responsible Mining Index, Responsible mining index, Accessed April 2018

The **Responsible Business Alliance** (formerly the Electronic Industry Citizenship Coalition) is an industry association with 110 members from the electronics, retail, auto and toy industries including major IT brands. Members commit to a Code of Conduct to improve the social, environmental and ethical standards in their supply chains. At a minimum, the Code of Conduct must be adhered to be the member companies and their first tier of suppliers.[4]

The **Global Electronics Sustainability Initiative** (GeSI) is an industry association that provides guidance on environmental and social sustainability. Several major IT brands are members.[5]

The **Fair Labor Association** (FLA) seeks to tackle abusive labour practices by helping companies conduct due diligence and advocating for greater accountability and transparency.[6] Member companies must meet the organisation's labour standards. Most of its members are clothing companies, but one big IT company is also a member.[7]

Members of the **International Council on Mining and Metals** must commit to the organisation's '10 principles' on human rights, development and the environment.[8] Their members include 25 of the world's biggest mining companies.[9]

Certification schemes

TCO Certified is a certification scheme for IT products, including monitors, laptops, tablets, smartphones, desktops, all-in-one PCs, projectors and headsets. Third-party auditors are used to assess whether a product meets the standard's requirements on social and environmental sustainability. These including criteria on child labour, workers' rights, health and safety and the reduction of use of hazardous substances. There are currently more than 2,800 products certified from 20 brands.[10]

The **Initiative for Responsible Mining Assurance** (IRMA) is a verification scheme that will use third-party auditors to assess whether mines meet the IRMA responsible mining standards. The scheme is expected to start in mid-2018.[11]

It is possible for electronics companies (as well as consumers) to buy **fairtrade-certified gold**. The Fairtrade Foundation, which is behind the standards for many fairtrade bananas, tea and coffee, also produce standards for fairtrade gold; they include requirements on working conditions, health and safety, child labour and environmental protection, as well as a minimum price for miners.[12] Fairphone uses fairtrade-certified gold.[13]

Fairmined gold is a certification scheme for artisanal and small-scale gold miners. At present, 10 mining organisations around the world are certified.[14]

Industry guidelines

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[4] Responsible Business Alliance, Home page, Accessed April 2018
[5] Global eSustainability Initiative, Home page, Accessed April 2018
[6] Fair Labor Association, Home page, Accessed April 2018
[7] Fair Labor Association, Apple joins FLA, 13 January 2012
[8] ICMM, ICMM 10 principles, Accessed April 2018
[9] ICMM, Our members, Accessed April 2018
[10] TCO Certified, Home page and Criteria designed for driving sustainable development, Accessed April 2018
[11] IRMA, Home page, Accessed April 2018
[12] Fairtrade Foundation, Gold miners, Accessed April 2018
[13] HuffPost, Support Fairtrade Gold With Your Next Smartphone, 9 March 2016
[14] Fairmined, Our impact, Accessed April 2018

The World Economic Forum developed a **Framework for Mining and Metals in a Sustainable World 2050**. It contains guiding principles around the environment, development, human rights and transparency.[15]

Conflict

The **EU Conflict Minerals Regulation** will come into force in the EU in 2021 and will require any company importing products containing tin, tungsten, tantalum or gold into the EU to source these minerals from responsible and conflict-free areas.[16] Section 1502 of the US **Dodd-Frank** Act requires American companies to conduct due diligence to minimise the risk that minerals coming from DRC or neighbouring countries funded conflict.

The **OECD Due Diligence Guidance** provides guidelines to companies sourcing minerals from conflict areas.[17]

The **Responsible Minerals Initiative** (RMI, formerly the conflict free smelter programme) uses third-party audits of smelter and refiner companies' management systems to assess whether the companies meet their standards. The standards are designed to demonstrate adherence to the OECD Guidance for Responsible Supply Chains of Minerals and the US Dodd-Frank Act.[18]

[15] World Economic Forum, Mining and Metals in a Sustainable World 2050: Report Launch, 11 September 2015
[16] European Commission, The regulation explained, Accessed April 2018
[17] OECD, OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, Accessed April 2018
[18] Responsible Minerals Initiative, Home page, Accessed April 2018

Mobile phones

Summary of the most severe risks

Assembly	Components	Raw materials
Forced overtime Low pay Health and safety issues, including people possibly dying from exposure to chemicals Trade union rights not respected Underage labour[19]	Forced overtime Low pay Health and safety issues, including people possibly dying from exposure to chemicals Trade union rights not respected Underage labour[20]	Child labour Forced labour Land grabbing Funding of armed groups Severe environmental impacts Severe health and safety issues Killing of protestors Trade union rights not respected Links to the illegal drugs trade (tin from Myanmar)
Medium-high risk	**High risk**	**Very high risk**

The product

It is difficult to draw up a definitive list of every material used in a smartphone, partly because companies protect this information as a trade secret and partly because of the variation between different models and manufacturers.[21] However, it is possible to draw up a general picture. Mobile phones consist of:

- A processor which is made from silicon bombarded with elements such as phosphorus, antimony, arsenic, boron, indium or gallium.[22]
- Circuit boards that primarily made from copper, gold and silver but also contain micro-capacitors which use tantalum, platinum, palladium, tungsten, niobium and rare earths, and

[19] The term 'underage labour' is used to mean 16 and 17 year olds working illegally. It is used to distinguish it from the worst forms of child labour involving younger children.
[20] The term 'underage labour' is used to mean 16 and 17 year olds working illegally. It is used to distinguish it from the worst forms of child labour involving younger children.
[21] TechRadar, Our smartphone addiction is costing the Earth, 4 August 2015
[22] The East African, Minerals in your mobile phone, 4 June 2015

resistors which are made of ceramic which is made of aluminium oxide.[23] The metals are mounted onto a board made of epoxy resin and fibreglass.[24]

- A screen and liquid crystal display. The screen is made from strengthened glass (aluminium oxide and silicon dioxide known as aluminosilicate glass) with an ultra-thin layer of indium tin oxide to make it touch-sensitive.[25] Rare-earth metals such as neodymium-iron-boron alloys, dysprosium and praseodymium are added to make it harder[26] and are also used to help make the red, green and blue colours on the screen.[27]
- A microphone and speakers which contain magnets usually made from gallium, arsenic and (in the case of speakers) cobalt and the rare earth mineral neodymium.[28]
- A motor to make the phone vibrate which contains tungsten and the rare earths neodymium and dysprosium.[29]
- Solder, to join the various parts of the phone together, usually made from an alloy of tin, silver and copper.[30] Lead is banned from consumer electronics in the EU.[31]
- A rechargeable lithium-ion battery which is made from nickel, cobalt, zinc, cadmium, copper and lithium.[32] Antimony helps make the battery charge.[33]
- A case which is made from metal, often aluminium or plastic.[34] The plastic may contain magnesium compounds.[35]

[23] Minerals Education Coalition, What's in my cell phone?, Accessed March 2018; Minerals Education Coalition, Cell phone minerals, Accessed March 2018; US Geological Service, Recycled Cell Phones—A Treasure Trove of Valuable Metals, July 2006; The East African, Minerals in your mobile phone, 4 June 2015; Techwalla, What Materials Are Used to Make Cell Phones?, Accessed March 2018; American Chemical Society, Smartphones: smart chemistry, Accessed March 2018; Fairphone, Smartphone material profile, 2017

[24] Musterkids, Mobile phone manufacturing, Accessed March 2018; MusterKids, Mobile phone resources, Accessed March 2018; Techwalla, What Materials Are Used to Make Cell Phones?, Accessed March 2018

[25] Minerals Education Coalition, Cell phone minerals, Accessed March 2018; The East African, Minerals in your mobile phone, 4 June 2015; Fairphone, Smartphone material profile, 2017

[26] American Chemical Society, Smartphones: smart chemistry, Accessed March 2018; Techwalla, What Materials Are Used to Make Cell Phones?, Accessed March 2018; The East African, Minerals in your mobile phone, 4 June 2015

[27] American Chemical Society, Smartphones: smart chemistry, Accessed March 2018

[28] Minerals Education Coalition, What's in my cell phone?, Accessed March 2018; Minerals Education Coalition, Cell phone minerals, Accessed March 2018; The East African, Minerals in your mobile phone, 4 June 2015; Fairphone, Smartphone material profile, 2017

[29] American Chemical Society, Smartphones: smart chemistry, Accessed March 2018; The East African, Minerals in your mobile phone, 4 June 2015

[30] MusterKids, Mobile phone resources, Accessed March 2018; Techradar, The weird and wonderful materials that make up your PC, 22 July 2012

[31] European Commission, Environment: EU ban on hazardous substances in electrical and electronic products takes effect, 30 June 2006

[32] Fairphone, Smartphone material profile, 2017; Musterkids, Mobile phone manufacturing, Accessed March 2018

[33] MusterKids, Mobile phone resources, Accessed March 2018

[34] MusterKids, Mobile phone resources, Accessed March 2018

[35] Minerals Education Coalition, Cell phone minerals, Accessed March 2018; The East African, Minerals in your mobile phone, 4 June 2015

The supply chain

Norway imports virtually all of its mobile phones from China (74%) or the Republic of Korea (20%).[36] Some of the big phone brands assemble the phones themselves and manufacture some of the components themselves[37]; others outsource all assembly and manufacture. When outsourcing, rival companies often source components from the same factories. [38]

At least one major phone brand maintains a list of all of the suppliers of the components for its products: they come from a wide variety of countries, with China, Japan, USA, Taiwan and South Korea topping the list. [39]

Assembly	**Components**	**Raw Materials**[40]
China[41] South Korea[42]	**Most common countries[43]:** China[44] Japan[45] South Korea[46] Taiwan[47] USA[48] **Other countries:** Austria[49]	**Aluminium**: China[63] **Antimony:** China[64] **Arsenic:** China, Morocco[65] **Boron:** Turkey[66] **Cadmium**: China, South Korea[67] **Cobalt**: DR Congo[68] **Copper**: Chile, Peru[69] **Gallium**: China, Japan, South Korea, Russia, Ukraine[70]

[36] UN Comtrade, Norway's official customs statistics, 2017
[37] Macworld, Where are Apple products made?, 18 September 2017
[38] Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013; Apple, Supplier list, February 2018; The Verge, Samsung's component division will make more money off the iPhone X than the Galaxy S8, 2 October 2017
[39] Apple, Supplier list, February 2018
[40] All countries that produce 10% or more of global production listed
[41] UN Comtrade, Norway's official customs statistics, 2017
[42] UN Comtrade, Norway's official customs statistics, 2017
[43] The top five countries lists as suppliers of Apple components; Apple, Supplier list, February 2018
[44] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013
[45] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013
[46] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013
[47] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013
[48] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013
[49] Apple, Supplier list, February 2018
[63] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[64] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[65] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[66] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[67] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[68] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[69] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[70] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018

	Belgium[50] Brazil[51] Germany[52] Indonesia[53] Ireland[54] Israel[55] Malaysia[56] Netherlands[57] Philippines[58] Singapore[59] Thailand[60] UK[61] Vietnam[62]	**Gold**: China, Australia, Russia[71] **Indium**: China, South Korea[72] **Lead**: China, Australia[73] **Lithium**: Australia, Chile, Argentina[74] **Magnesium**: China[75] **Nickel**: Indonesia, Philippines, New Caledonia (Overseas Territory of France), Canada[76] **Niobium:** Brazil[77] **Palladium**: Russia, South Africa[78] **Phosphate:** China, United States, Morocco and Western Sahara[79] **Plastic, from oil and gas**: Saudi Arabia, Russia, United Arab Emirates, Canada, Nigeria (oil); and Qatar, Norway, United States (gas) **Platinum**: South Africa, Russia[80]

[50] Apple, Supplier list, February 2018
[51] Apple, Supplier list, February 2018
[52] Apple, Supplier list, February 2018
[53] Apple, Supplier list, February 2018
[54] Apple, Supplier list, February 2018
[55] Apple, Supplier list, February 2018
[56] Apple, Supplier list, February 2018
[57] Apple, Supplier list, February 2018
[58] Apple, Supplier list, February 2018
[59] Apple, Supplier list, February 2018
[60] Apple, Supplier list, February 2018
[61] Apple, Supplier list, February 2018
[62] Apple, Supplier list, February 2018
[71] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018. No single country produces more than 10% of the world's supply of gold; the top three producing countries are included here
[72] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[73] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[74] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[75] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[76] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[77] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[78] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[79] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[80] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018

		Rare-earth metals[81]**:** China, Australia[82] **Silicon**: China[83] **Silver**: Mexico, Peru, China[84] **Tantalum**: Rwanda, DR Congo, Nigeria[85] **Tin**: China, Indonesia, Myanmar[86] **Tungsten**: China[87] **Zinc**: China, Peru[88]

Risks

Assembly

Most mobile phones are assembled in China. For the well-known phone brands, there has been considerable research into the labour rights conditions in those factories (see below). In general though, in China, there is a high risk of human rights abuses in factories including child labour[89] and forced and bonded labour.[90] Health and safety conditions are poor.[91] There is a risk that people are paid very low wages and/or required to work excessively long hours.[92] Migrant workers constitute a particularly vulnerable group, in which people risk being exploited and often lack proper contracts and access to social security.[93] Trade union rights are not respected in China as the state does not allow independent trade unions.[94]

[81] An iPhone contains eight different rare-earth metals. Across several varieties of smartphones there are 16 of the 17 rare earth metals. The only one you will not find is promethium, which is radioactive. American Chemical Society, Smartphones: smart chemistry, Accessed March 2018
[82] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[83] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[84] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[85] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[86] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[87] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[88] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[89] China Labor Watch, reports on toy factories in China, Retrieved 2017-11-02; International Labor Rights Forum, Six cents an hour, 1996
[90] Topical research digest: Human rights and contemporary slavery, The dark side of labour in China, Retrieved 2017-11-02
[91] International Journal of Occupational and Environmental Health, Occupational Health and Safety in China, Oct/Dec 2003; Labor Watch Pakistan, Safety at workplace, 2015-08-24
[92] South China Morning Post, 'Low pay, long hours': life inside factory that supplied Ivanka Trump brand in China, 2017-06-28; The Guardian, The grim truth of Chinese factories producing the west's Christmas toys, 2016-12-04; China Labor Watch, Minimum wage standards in China, 2016; International Labor Rights Forum, Six cents an hour, 1996
[93] China Labour Bulletin, Migrant workers and their children, Retrieved 2017-11-30
[94] ITUC, Survey of violations of trade union rights in China, 2016-2017

One of the companies that assembles phones is the single largest employer in mainland China employing 1.3 million people. [95] China Labor Watch has carried out extensive investigations into the human rights conditions atfactories where phones are assembled[96] and has documented labour rights violations including forced overtime and paying wages so low that employees are effectively forced to work overtime. A 2017 investigation by the Financial Times also documented interns working overtime illegally.[97]

In 2010, a factory where phones are assembled was in the news after a spate of suicides among assembly-line workers in protest at the long working hours, humiliation by managers and unfair fines. It should be noted however that the rate of suicide was within the national average.[98]

There are reports that a major phone company in South Korea has policies to discourage trade union membership, of workers committing suicide to protest against poor working conditions and of significant health and safety issues.[99] A report by the International Trade Union Federation references a worker safety group which documented more than 200 cases of serious illnesses, including leukaemia, lupus, lymphoma, multiple sclerosis and brain tumours among former semiconductor and LCD workers. [100] Seventy-six workers have died, most in their 20s and 30s.[101] An Associated Press investigation found that, at the company's request, South Korean authorities withheld information about the chemicals people were exposed to from sick workers and bereaved families, citing trade secrets.[102]

Components

The components for one major phone company come from a wide range of companies in a wide range of countries. Most, however, come from China. China Labor Watch has documented labour rights issues in several of these factories. An investigation into the company supplying casings found issues of forced, unpaid overtime, improper handling of hazardous materials and that safety equipment not always available.[103] An investigation into another major supplier found violations with health and safety, pollution and work schedules. An episode of toxic gas poisoning occurred at the factory in May 2017 in which 90 workers had to be hospitalised, five of them in intensive care.[104]

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[95] The Guardian, Life and death in Apple's forbidden city, 18 January 2017

[96] China Labor Watch, Apple is the Source of Mistreatment of Chinese Workers, 24 August 2016; 9to5Mac, Report details workers' rights violations at Apple's iPhone 7 supplier Pegatron, 25 August 2016; China Labor Watch, Something's Not Right Here: Poor Working Conditions Persist at Apple Supplier Pegatron, 22 october 2015; Reuters, Rights group says Apple suppliers in China breaking labor laws, 28 June 2002

[97] Quartz, Apple's suppliers are allegedly skirting China's labor laws to make the iPhone X, 21 November 2017

[98] The Guardian, Life and death in Apple's forbidden city, 18 January 2017

[99] International Trade Union Confederation, Global reach of Samsung's medieval practices revealed in new report, 5 October 2016

[100] International Trade Union Confederation, Global reach of Samsung's medieval practices revealed in new report, 5 October 2016

[101] Al Jazeera, Report: Samsung endangered workers health in S Korea, 10 August 2016

[102] Associated Press, 2 words keep sick Samsung workers from data: trade secrets, 11 August 2016; Al Jazeera, Report: Samsung endangered workers health in S Korea, 10 August 2016

[103] Bloomberg, Apple Supplier Workers Describe Noxious Hazards at China Factory, 17 January 2018; The Verge, Apple supplier workers have been exposed to toxic chemicals, report finds, 16 January 2018

[104] China Labor Watch, Apple's Failed CSR Audit A Report on Catcher Technology Polluting the Environment and Harming the Health of Workers, 16 January 2018; Supply Chain Dive, Labor and health violations rampant at Apple supplier in China, 23 January 2018

The components for another major phone company mainly come from factories in South Korea and China. China Labor Watch has documented underage labour (16 and 17 year olds), excessive overtime and discrimination against men, older people and disabled people when hiring at this company's suppliers.[105] In one case in 2012, children under 16 were found working 11 hours a day without contracts.[106]

Health and safety is an issue in the manufacturing of batteries and other electronic components as they require handling a large number of chemicals. If personal protective gear and other safety measures are not used workers can be exposed to hazardous fumes and toxic chemicals[107] which can cause cancer, skin burns and eye damage as well as other reactions and diseases.[108] South Korea Human Rights Monitor has documented issues around occupational health and safety, including numerous cases of young workers dying, apparently as a result of exposure to chemicals.[109]

In general, forced labour and child labour are reported from the electronics industry in China.[110] Migrant workers constitute a large share of the workforce in the manufacturing sector in both China and South Korea, and are in general more at risk of exploitation and discrimination. In China, migrant workers from rural areas often lack contracts and access to social security and are forced to leave their children behind with family as they often do not have the means to support them.[111]

Raw materials

This section first lists the risks related to oil and gas and then lists the risks associated with mining and smelting the numerous metals used in phones. The risks are listed by country, in alphabetical order.

The **oil** used to manufacture the plastics used in phones is extracted in a number of places around the world with very limited traceability. Oil extraction is linked to environmental and social risks in Saudi Arabia, Russia, United Arab Emirates and Nigeria, including lack of union rights, poor working conditions and forced labour as well as oil spills leading to health impacts and contamination of soil and water for surrounding communities.[112] Oil extraction in high-risk environments has also been linked to sexual exploitation and abuse of women in surrounding areas.[113]

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[105] China Labor Watch, Samsung's Supplier Factory Exploiting Child Labor, 8 August 2012; China Labor Watch, CLW Research Casts Doubt on the Validity of Samsung's Corporate Social Responsibility Report, 17 May 2016; China Labor Watch, Follow-up Investigative Report on HEG Technology, 18 November 2015

[106] New York Times, Despite a pledge by Samsung, child labor proves resilient, 10 July 2014; China Labor Watch, Samsung, HEG, and Vocational School Cover-up Truth About Child Labor, 3 December 2014; China Labor Watch, Another Samsung supplier factory exploiting child labor, 10 July 2014

[107] United States Department of Labor, Battery manufacturing, 2017-11-30

[108] Globalisation Monitoring, The Chinese Battery Industry: The Truth behind the Charge, 2012

[109] Human Rights Monitor South Korea, 56th death of former Samsung employee from occupational disease, Accessed April 2018

[110] List of Goods Produced by Child Labor or Forced Labor, Retrieved 2017-12-18

[111] China Labour Bulletin, Migrant workers and their children, Retrieved 2017-11-30

[112] Utrikesdepartementet, Mänskliga rättigheter i Saudiarabien 2011, Retrieved 2017-10-27; ILO, Working Paper No. 267, Working conditions of contract workers in the oil and gas industries, 2010; The Degradation of Work, Oil and Casualization of Labor in the Niger Delta, 2010; Oil price.com, Nigerian Oil Workers Go On Strike, Stop Production At Several Flow Stations, 2017; The Guardian, Shell Nigeria oil spill '60 times bigger than claimed', 2012-04-23

[113] Wday, The Bakken's dirty secret: sex trafficking has growing precense in oil patch experts say 2014-05-06, Al Jazeera, The Dark side of the oil boom: Human trafficking in the Heartland, 2014-04-28, Columbia law school,

Mining is one of the most high-risk sectors in the world and in most countries, mining remains of the most hazardous occupations when the number of people exposed to risk is taken into account.[114] Mining extraction in high-risk environments has been linked to sexual exploitation and abuse of women in surrounding areas.[115] Mines require a high level of water use and quite a few of the countries listed below have areas where there is a risk of water shortage.[116] Mining often produces toxic waste products and airborne pollutants that are harmful to human health. Heavy metals such as arsenic and cadmium can induce multiple organ damage, even at lower levels of exposure.[117] Many metals are energy intensive to produce and therefore associated with high levels of CO_2 emissions. Low recycling rates are an issue. For example, cobalt consumption is expected to exceed production by 2020, and gold may become unavailable from mining within 100 years.[118]

In **Argentina,** lithium mining is linked to land grabbing and forcible relocation of indigenous communities off their land.[119]

The mining industry in general in **Brazil** has been accused of throwing people off their land and having an extremely poor health and safety record.[120]

In **Chile,** lithium mining is associated with land grabbing and the displacement of indigenous people off their land.[121] Silver mining is linked to water pollution, land controversies, killings of protestors, and failure to respect indigenous peoples' rights.[122] The extraction and processing of silver requires chemicals such as cyanide and mercury. Both can be harmful to humans and the environment. If not managed properly, exposure to mercury can damage the central nervous system and the kidneys.[123] Copper mining is associated with depletion of water resources in the Atacama desert, air pollution and respiratory problems. [124]

China provides more of the minerals used in phones than any other country. These include aluminium, antimony, arsenic, cadmium, gallium, gold, indium, lead, magnesium, phosphate, rare-earth metals, silicon, silver, tin, tungsten and zinc.

China's mining industry has a poor safety record. The industry is associated with severe environmental impacts, poor working conditions, and limited labour rights for workers. Lack of safety

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Righting wrongs? Barrick Gold's remedy mechanism for sexual violence in Papua New Guinea November 2015

[114] ILO, Mining: A Hazardous work, Retrieved 2017-11-28

[115] Wday, The Bakken's dirty secret: sex trafficking has growing precense in oil patch experts say 2014-05-06, Al Jazeera, The Dark side of the oil boom: Human trafficking in the Heartland, 2014-04-28, Columbia law school, Righting wrongs? Barrick Gold's remedy mechanism for sexual violence in Papua New Guinea November 2015

[116] World Resource Institute, Mine the Gap: Connecting Water Risks and Disclosure in the Mining Sector 2010

[117] US National Library of Medicine, Heavy metals toxicity and the environment, 26 August 2014

[118] Fairphone, Smartphone material profile, 2017

[119] Todd Frankel and Peter Whoriskey, Tossed Aside In The 'White Gold' Rush, Retrieved 2017-11-1

[120] Mining.com, Report investigates human rights abuse linked to Kinross Gold's Brazilian mine, 11 December 2017; International Federation for Human Rights, How much are human rights worth in the Brazilian mining and steel industry?, 18 May 2011

[121] Todd Frankel and Peter Whoriskey, Tossed Aside In The 'White Gold' Rush, Retrieved 2017-11-1

[122] Telesur, Canadian Mining Giant Violently Evicts Villagers in Mexico, 2017-01-31, The Guardian, The Canadian company mining hills of silver – and the people dying to stop it, 2017-07-13, Observatorio de Conflictos Mineros en América Latina, Juan Claro, Julio Ponce y Pascua Lama, algunos de los casos más polémicos que esperan decisiones clave del Tribunal Ambiental, 2017-09-13

123 Enact Sustainable Strategies, Riskanalys: Förband och sårvård, 2017

[124] Fairphone, Smartphone material profile, 2017

is a major problem, which has resulted in many deaths in the Chinese mining industry. [125] Greenpeace has documented contamination of water and land around Asia's largest zinc and lead mine and smelter in China. Emissions have impacted the health of local communities. It is estimated that a third of all lead poisoning in China has been caused by smelting lead and zinc.[126]

China has imposed stricter environmental regulations on bauxite (aluminium) smelters, forcing some to shut down.[127] Bauxite mining in China has social and environmental impacts. Bauxite is extracted from open mine pits, which can cause leaching of toxic substances, dust and water pollution, soil erosion, water shortage and negative impacts on biodiversity.[128] Chinese mine sites have been found to rely on large numbers of migrant workers, who receive less pay and often work without personal protection equipment.[129]

There have been large-scale spillages of toxic “red mud” waste reportedly linked to bauxite (aluminium and gallium) mining and processing due to poor storage and tailing dams overflowing, causing environmental degradation, displacement of communities and reported mortalities. Many mines were closed in 2016 due to widespread water and soil contamination and risks to public health.[130]

Gold is a fast-growing industry in China, often leading to inadequate infrastructure that is associated with poor health and safety in underground mines, high risk of respiratory disease (silicosis), toxic water and soil contamination. [131]

There is evidence of soil and water contamination by heavy metals, particularly cadmium and lead, in zinc/lead mining and processing regions.[132]

The mining of rare earths has caused the contamination of farmland and the creation of toxic lakes in Inner Mongolia. Air pollution is linked to respiratory illness, skin diseases and cancer. Artisanal and small-scale mining has contributed to these negative effects, prompting a crackdown on unregulated activity and a tightening of environmental regulations.[133]

In the tin mining sector artisanal and small-scale production is associated with a high incidence of respiratory disease, especially silicosis. [134]

Tungsten mining is linked to the destruction of UNESCO-protected forests in Yunnan province.[135]

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[125] US Geological Survey, 2013 Minerals Yearbook, China; Mining Technology, China's appalling mining death rate – dealing with 'disorderly' management 2012-10-31
[126] Greenpeace, Investigation finds pollution and illness ignored at Asia's largest lead mine, Yunnan Province 2015-06-09
[127] Reuters, Alumina shortages to increase as Chinese crackdown bites, 2017-10-19; Industrial Minerals, Environmental tax to end era of cheap Chinese minerals, 2017-06-30; Asociación Nacional de Fabricantes de Productos Refractarios, Materiales y Servicios Afines, Massive production shutdown in China lifts bauxite prices, 2017-06-05
[128] The Wilderness Society, Bauxite mining threatens Wild Rivers 2015-07-31; Naturskyddsföreningen, Bra Miljöval – Kriterier 2013:4 2013
[129] Enact Sustainable Strategies, Riskanalys: instrument, 2017
[130] Fairphone, Smartphone material profile, 2017
[131] Fairphone, Smartphone material profile, 2017
[132] Fairphone, Smartphone material profile, 2017
[133] Fairphone, Smartphone material profile, 2017
[134] Fairphone, Smartphone material profile, 2017
[135] Fairphone, Smartphone material profile, 2017

For the mining of indium, there is a risk that inadequate storage facilities leads to toxic heavy metals leaching into the environment if not adequately managed and stored. [136]

There is a high risk of the worst forms of human rights abuses in the mining industry in the **Democratic Republic of Congo (DRC)**. DRC is the largest supplier of cobalt in the world, and child labour, forced labour, the forced relocation of local communities, bribery and deplorable working conditions are reported.[137] Amnesty International has documented children as young as seven working mining the cobalt that goes into phone batteries.[138] There is evidence that cobalt is used to finance armed groups in the DRC, and is currently under consideration as a fifth conflict mineral to be regulated by the EU (in addition to gold, tantalum, tin and tungsten).[139] Mining communities are exposed to dangerous levels of contaminated dust and water.[140]

The mining of tantalum in the DRC is also associated with high levels of child labour, forced labour, a high risk of serious health impacts on nearby communities and loss of habitat for a critical endangered gorilla.[141] Tantalum is a designated as being a "conflict mineral" due to its association with the funding of armed groups in the DRC meaning that, from 2021, EU companies will be required to source tantalum from responsible, conflict-free areas.[142]

In **Indonesia,** 6,300 children work in the informal tin mining sector, 30% of them aged 14 or less.[143] There is a severe risk of environmental issues associated with tin mining, especially in marine areas where seabed mining sometimes takes place. Some of the mining is carried out by artisanal miners where there is a high risk of health and safety issues including respiratory diseases.[144]

10% of **Morocco**'s phosphate production comes from Western Sahara.[145] The status of Western Sahara is a disputed territory, claimed by both Morocco and a Sahrawi liberation movement. Some of it is administered by Morocco and some by Polisario, the liberation movement. No country recognises Morocco's annexation of Western Sahara.

A majority of the tin from **Myanmar** comes from the de-facto autonomous Wa state [146] which is run by the United Wa State Army, an insurgent group that the US government lists as a significant producer of methamphetamines[147] and, until recently, considered to be one of the largest heroin producing and trafficking organisations in the world.[148] Large-scale industrial tin mining projects in Myanmar have had a severe impact on local ecosystems. Two mines were closed in 2016 for failing

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[136] Fairphone, Smartphone material profile, 2017
[137] Todd Frankel, The Cobalt Pipeline,The Washington Post, Retrieved 2017-10-31; Todd Frankel, The Cobalt Pipeline,The Washington Post, Retrieved 2017-10-31; Fairphone, Smartphone material profile, 2017
[138] Amnesty International, Exposed: Child labour behind smart phone and electric car batteries, 19 January 2016
[139] Fairphone, Smartphone material profile, 2017
[140] Fairphone, Smartphone material profile, 2017
[141] Fairphone, Smartphone material profile, 2017
[142] European Commission, Conflict minerals: the regulation explained, Accessed April 2018
[143] K4D, Overview of child labour in the artisanal and small-scale mining sector in Asia and Africa, 4 October 2017
[144] Fairphone, Smartphone material profile, 2017
[145] Western Sahara Resource Watch, The phosphate exports, 29 July 2007
[146] Fairphone, Smartphone material profile, 2017
[147] US Department of State, International narcotics control strategy report, March 2017
[148] US Drug Enforcement Administration, Eight High-Ranking Leaders Of Southeast Asia's Largest Narcotics Trafficking Organization Indicted By A Federal Grand Jury In Brooklyn, New York, 24 January 2005

to uphold environmental regulation after villagers filed a lawsuit for water and soil pollution, degradation of farmland, reduced biodiversity and risks to public health. [149]

New Caledonia is an overseas territory of France. It is due to hold a referendum on independence in November 2018. Nickel mining there is associated with water pollution, deforestation, biodiversity loss and the pollution and destruction of coral reefs.[150]

In the **Phillippines**, the mining of nickel is linked to human rights and environmental impacts. The Philippines is one of the most dangerous countries for anti-mining activists, especially indigenous peoples' activists, and mining has caused conflict over land, particularly where Free, Prior and Informed Consent has not been obtained.[151]

Peru's Human Rights Ombudsman lists industrial mining as bring the top cause of conflict in the country due to environmental concerns and lack of job generation. Copper mining has doubled in the last five years, leading to the depletion of water resources in the Andes. There was sharp rise in violent conflict in 2015 which is linked to copper mining. Several protesters have been killed by police.[152] Copper mining is linked to the production of toxic waste which can damage surrounding land, water, animals and plants.[153] Zinc mining is linked to water pollution and water shortages, anti-union activities and land conflicts impacting local communities.[154]

In **Russia**, the mining of nickel is linked to human rights and environmental impacts.[155] There has been an increase in the amount of gold dredging in Russia as a result of the ban on dredge mining in China. Gold dredging is associated with mercury contamination in Russia.[156]

In **Rwanda**, tantalum mining is usually carried out by artisanal and small-scale miners. It is associated with child labour and tax avoidance. Much of the tantalum is labelled as coming from Rwanda actually comes from the DRC.[157]

In **Ukraine**, there have been large-scale spillages of toxic "red mud" waste reportedly linked to bauxite (aluminium and gallium) mining and processing due to poor storage and tailing dams overflowing – causing environmental degradation, displacement of communities and reported mortalities.[158]

Laptops

Summary of the most severe risks

Assembly	Components	Raw materials

[149] Fairphone, Smartphone material profile, 2017
[150] Fairphone, Smartphone material profile, 2017
[151] Fairphone, Smartphone material profile, 2017
[152] Fairphone, Smartphone material profile, 2017
[153] Global Policy, From the ore to the car - summary, University of Virginia, Copper Mining from the ground up Retrieved 2017-11-17
[154] Swedwatch, Rena guldgruvan AP-fondernas investeringar har en smutsig baksida 2011
[155] Fairphone, Smartphone material profile, 2017
[156] Fairphone, Smartphone material profile, 2017
[157] Fairphone, Smartphone material profile, 2017
[158] Fairphone, Smartphone material profile, 2017

Forced overtime Low pay Health and safety issues, including people possibly dying from exposure to chemicals Trade union rights not respected Underage labour[159]	Forced overtime Low pay Health and safety issues, including people possibly dying from exposure to chemicals Trade union rights not respected Underage labour[160]	Child labour Forced labour Land grabbing Funding of armed groups Severe environmental impacts Severe health and safety issues Killing of protestors Trade union rights not respected Links to the illegal drugs trade (tin from Myanmar)
Medium-high risk	**High risk**	**Very high risk**

The product

With a few exceptions, laptops contain the same components as mobile phones:

- A central processing unit which is made from silicon bombarded with elements such as phosphorus, antimony, arsenic, boron, indium or gallium.[161] Intel and IBM started using the element hafnium in their chips a few years ago.[162]
- Circuit boards that primarily made from copper, gold and silver but also contain micro-capacitors which use tantalum, platinum, palladium, tungsten, niobium and rare earths, and resistors which are made of ceramic which is made aluminium oxide.[163] The metals are mounted onto a board made of epoxy resin and fibreglass.[164]

[159] The term 'underage labour' is used to mean 16 and 17 year olds working illegally. It is used to distinguish it from the worst forms of child labour involving younger children.
[160] The term 'underage labour' is used to mean 16 and 17 year olds working illegally. It is used to distinguish it from the worst forms of child labour involving younger children.
[161] The East African, Minerals in your mobile phone, 4 June 2015; Techradar, The weird and wonderful materials that make up your PC, 22 July 2012
[162] Techradar, The weird and wonderful materials that make up your PC, 22 July 2012
[163] Minerals Education Coalition, What's in my cell phone?, Accessed March 2018; Minerals Education Coalition, Cell phone minerals, Accessed March 2018; US Geological Service, Recycled Cell Phones—A Treasure Trove of Valuable Metals, July 2006; The East African, Minerals in your mobile phone, 4 June 2015;; American Chemical Society, Smartphones: smart chemistry, Accessed March 2018; Fairphone, Smartphone material profile, 2017; Techwalla, What Elements Are Used in Laptops?, Accessed April 2018
[164] Musterkids, Mobile phone manufacturing, Accessed March 2018; MusterKids, Mobile phone resources, Accessed March 2018; Techwalla, What Materials Are Used to Make Cell Phones?, Accessed March 2018

- A hard drive, made of glass or an alloy of aluminium and magnesium plus small amounts of other elements like silicon, copper and zinc, which is then coated in a layer of nickel and phosphorus. A hard disk head which contains a magnet primarily made of neodymium.[165]
- A screen which comprises a liquid crystal display (LCD) backlit with LED lights.[166] It is made from glass coated with a very thin layer of indium tin oxide. [167]
- A microphone and speakers which contain magnets usually made from gallium, arsenic and (in the case of speakers) cobalt and the rare earth mineral neodymium.[168]
- Solder, to join the various parts of the laptop together, usually made from an alloy of tin, silver and copper.[169] Lead is banned from consumer electronics in the EU.[170]
- A rechargeable lithium-ion battery which is made from nickel, cobalt, zinc, cadmium, copper and lithium. [171] Antimony helps make the battery charge.[172]
- A case which is made from metal, often aluminium or plastic.[173] The plastic may contain magnesium compounds.[174]

The supply chain

Norway imports virtually all (88%) of its laptops from China.[175] No other single country makes up more than 2% of the imports. One major brand of laptops maintains a list of all of the suppliers of the components for its products: they come from a wide variety of countries, with China, Japan, USA, Taiwan and South Korea topping the list. [176] Other laptop manufacturers make more of the components themselves rather than sourcing from other companies.[177]

A major manufacturer of computer processors has factories in the US, Ireland, Israel, Malaysia, Vietnam and China.[178] The next biggest manufacturers of processors[179] have factories located in South Korea, Taiwan, China, the US and Singapore.[180]

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[165] Techradar, The weird and wonderful materials that make up your PC, 22 July 2012
[166] Laptopscreen, Is my screen LED or LCD, 14 November 2014
[167] Quora.com, What is a computer screen made of, 23 March 2017; Techwalla, What Elements Are Used in Laptops?, Accessed April 2018
[168] Minerals Education Coalition, What's in my cell phone?, Accessed March 2018; Minerals Education Coalition, Cell phone minerals, Accessed March 2018; The East African, Minerals in your mobile phone, 4 June 2015; Fairphone, Smartphone material profile, 2017
[169] MusterKids, Mobile phone resources, Accessed March 2018; Techradar, The weird and wonderful materials that make up your PC, 22 July 2012
[170] European Commission, Environment: EU ban on hazardous substances in electrical and electronic products takes effect, 30 June 2006
[171] Fairphone, Smartphone material profile, 2017; Musterkids, Mobile phone manufacturing, Accessed March 2018; Techwalla, What Elements Are Used in Laptops?, Accessed April 2018
[172] MusterKids, Mobile phone resources, Accessed March 2018
[173] MusterKids, Mobile phone resources, Accessed March 2018; Techwalla, What Elements Are Used in Laptops?, Accessed April 2018
[174] Minerals Education Coalition, Cell phone minerals, Accessed March 2018; The East African, Minerals in your mobile phone, 4 June 2015
[175] Lifewire, Where is the iPhone made?, 13 October 2017
[176] Apple, Supplier list, February 2018
[177] Macworld, Where are Apple products made?, 18 September 2017
[178] Intel, Fab and assembly/test sites, Accessed April 2018
[179] Investopedia, The world's top 10 semiconductor companies, 11 December 2017
[180] Samsung, Manufacturing centers, Accessed April 2018; TSMC, Fab locations, Accessed April 2018

Assembly	Components	Raw Materials[181]
China[182]	China[183] Japan[184] South Korea[185] Taiwan[186] USA[187] Singapore [188]	**Aluminium**: China[189] **Antimony:** China[190] **Arsenic:** China, Morocco[191] **Boron:** Turkey[192] **Cadmium**: China, South Korea[193] **Cobalt**: DR Congo[194] **Copper**: Chile, Peru[195] **Gallium**: China, Japan, South Korea, Russia, Ukraine[196] **Gold**: China, Australia, Russia[197] **Hafnium: Australia, South Africa[198]** **Indium**: China, South Korea[199]

[181] All countries that produce 10% or more of global production listed
[182] UN Comtrade, Norway's official customs statistics, 2017
[183] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013; Samsung, Manufacturing centers, Accessed April 2018; TSMC, Fab locations, Accessed April 2018
[184] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013
[185] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013; Samsung, Manufacturing centers, Accessed April 2018
[186] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013; TSMC, Fab locations, Accessed April 2018
[187] Apple, Supplier list, February 2018; Reuters, A stretched Samsung chases rival Apple's suppliers, 17 May 2013; Samsung, Manufacturing centers, Accessed April 2018; TSMC, Fab locations, Accessed April 2018
[188] TSMC, Fab locations, Accessed April 2018
[189] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[190] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[191] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[192] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[193] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[194] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[195] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[196] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[197] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018. No single country produces more than 10% of the world's supply of gold; the top three producing countries are included here
[198] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018. World hafnium production figures are not available. Hafnium is found with zirconium and it is zirconium production that is listed here. This fits with information from the Minerals Education Coalition.
[199] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018

		Lead: China, Australia[200] **Lithium**: Australia, Chile, Argentina[201] **Magnesium**: China[202] **Nickel**: Indonesia, Philippines, New Caledonia (Overseas Territory of France), Canada[203] **Niobium:** Brazil[204] **Palladium**: Russia, South Africa[205] **Phosphate:** China, United States, Morocco and Western Sahara[206] **Plastic, from oil and gas**: Saudi Arabia, Russia, United Arab Emirates, Canada, Nigeria (oil); and Qatar, Norway, United States (gas) **Platinum**: South Africa, Russia[207] **Rare-earth metals[208]:** China, Australia[209] **Silicon**: China[210] **Silver**: Mexico, Peru, China[211] **Tantalum**: Rwanda, DR Congo, Nigeria[212]

[200] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[201] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[202] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[203] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[204] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[205] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[206] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[207] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[208] An iPhone contains eight different rare-earth metals. Across several varieties of smartphones there are 16 of the 17 rare earth metals. The only one you will not find is promethium, which is radioactive. American Chemical Society, Smartphones: smart chemistry, Accessed March 2018
[209] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[210] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[211] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[212] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018

		Tin: China, Indonesia, Myanmar[213] **Tungsten**: China[214] **Zinc**: China, Peru[215]

Risks

Assembly

Most laptops are assembled in China where there is a high risk of human rights abuses in factories including child labour[216] and forced and bonded labour.[217] Health and safety conditions are poor.[218] There is a risk that people are paid very low wages and/or required to work excessively long hours.[219] Migrant workers constitute a particularly vulnerable group, in which individuals risk being exploited and often lack proper contracts and access to social security.[220] Trade union rights are not respected in China as the state does not allow independent trade unions.[221]

China Labor Watch has carried out extensive investigations into the human rights conditions atfactories in China where laptops are assembled and has documented labour rights violations including forced overtime and paying wages so low that employees are effectively forced to work overtime. [222] A 2017 investigation by the Financial Times also documented interns working overtime illegally.[223]

In 2010, a factory where laptops are assembled was in the news after a spate of suicides among assembly-line workers in protest at the long working hours, humiliation by managers and unfair fines. It should be noted however that the rate of suicide was within the national average [224]

There are reports that a major laptop company in South Korea has policies to discourage trade union membership, of workers committing suicide to protest against poor working conditions and of health and safety issues.[225] The report by the International Trade Union Federation references a worker

[213] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[214] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[215] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[216] China Labor Watch, reports on toy factories in China, Retrieved 2017-11-02; International Labor Rights Forum, Six cents an hour, 1996
[217] Topical research digest: Human rights and contemporary slavery, The dark side of labour in China, Retrieved 2017-11-02
[218] International Journal of Occupational and Environmental Health, Occupational Health and Safety in China, Oct/Dec 2003; Labor Watch Pakistan, Safety at workplace, 2015-08-24
[219] South China Morning Post, 'Low pay, long hours': life inside factory that supplied Ivanka Trump brand in China, 2017-06-28; The Guardian, The grim truth of Chinese factories producing the west's Christmas toys, 2016-12-04; China Labor Watch, Minimum wage standards in China, 2016; International Labor Rights Forum, Six cents an hour, 1996
[220] China Labour Bulletin, Migrant workers and their children, Retrieved 2017-11-30
[221] ITUC, Survey of violations of trade union rights in China, 2016-2017
[222] Reuters, Rights group says Apple suppliers in China breaking labor laws, 28 June 2002
[223] Quartz, Apple's suppliers are allegedly skirting China's labor laws to make the iPhone X, 21 November 2017
[224] The Guardian, Life and death in Apple's forbidden city, 18 January 2017
[225] International Trade Union Confederation, Global reach of Samsung's medieval practices revealed in new report, 5 October 2016

safety group which it says documented more than 200 cases of serious illnesses, including leukaemia, lupus, lymphoma, multiple sclerosis and brain tumours among former semiconductor and LCD workers. [226] Seventy-six workers have died, most in their 20s and 30s.[227] An Associated Press investigation found that, at the company's request, South Korean authorities withheld information about the chemicals people were exposed to from sick workers and bereaved families, citing trade secrets.[228] An investigation by SOMO found labour rights violations at factories in the Philippines that supply other brands of laptop, including mandatory 12 hours days, forced overtime and unrecognized rights to form labour unions.[229]

An investigation by China Labor Watch into a Chinese manufacturer of several big brands of computer found labour rights violations including large amounts of unpaid overtime, mandatory overtime hours twice the legal limit and poor-quality accommodation with 12 people per room.[230]

Components

The components for one major laptop company come from a wide range of companies in a wide range of countries. An investigation by China Labor Watch into one of these a suppliers found violations with occupational health and safety, pollution and work schedules. An episode of toxic gas poisoning occurred at the factory in May 2017 in which 90 workers had to be hospitalised, five of them in intensive care.[231]

A Chinese factory making parts for several big brands of laptop has been found to require student interns as young as 16 to work 12 hour days in order to receive their diploma.[232] An investigation into labour rights at factories in China and the Phillippines supply Acer found long hours, low pay and poor health and safety have been found at a Chinese factory making parts for laptops.[233] Former workers for factories supplying a large number of major laptop brands report lack of personal protective equipment when dealing with dangerous chemicals; the health of several workers has been damaged.[234]

Health and safety is an issue in the manufacturing of batteries and other electronic components as they require handling a large number of chemicals. If personal protective gear and other safety measures is not used, or is insufficient, workers could be exposed to hazardous fumes and toxic metals such as nickel, lithium and zinc or acids, solvents and electrolytes,[235] which can cause cancer,

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[226] International Trade Union Confederation, Global reach of Samsung's medieval practices revealed in new report, 5 October 2016
[227] Al Jazeera, Report: Samsung endangered workers health in S Korea, 10 August 2016
[228] Associated Press, 2 words keep sick Samsung workers from data: trade secrets, 11 August 2016; Al Jazeera, Report: Samsung endangered workers health in S Korea, 10 August 2016
[229] SOMO, CSR behaviour of MNO's in global ICT supply chain Philippines, 1 April 2005
[230] China Labor Watch, Major labor violations in a Quanta Computer factory, 7 February 2014
[231] China Labor Watch, Apple's Failed CSR Audit A Report on Catcher Technology Polluting the Environment and Harming the Health of Workers, 16 January 2018; Supply Chain Dive, Labor and health violations rampant at Apple supplier in China, 23 January 2018
[232] The Guardian, Chinese factory supplying major laptop brands accused of student labour abuses, 6 October 2017
[233] SOMO, Acer and Fujitsu Siemens Computers irresponsible, 10 December 2005; SOMO, Acer Incorporated, 1 December 2005
[234] SOMO, Report reveals victim stories of chemical poisoning in electronics industry in China, 5 September 2016
[235] United States Department of Labor, Battery manufacturing, 2017-11-30

skin burns and eye damage as well as other reactions and diseases.[236] South Korea Human Rights Monitor has documented issues around occupational health and safety, including numerous cases of young workers dying, apparently as a result of exposure to chemicals.[237]

In general, forced labour and child labour are reported from the electronics industry in China.[238] Migrant workers constitute a large share of the workforce in the manufacturing sector in both China and South Korea, and are in general more at risk of exploitation and discrimination. In China, migrant workers from rural areas often lack contracts and access to social security and are forced to leave their children behind with family as they often do not have the means to support them.[239]

There are often issues with trade union rights in China. When workers in factories supplying parts to major laptop companies have stood together to demand fairer wages and conditions, their leaders have been sacked. [240]

Raw materials

This section first lists the risks related to oil and gas and then lists the risks associated with mining and smelting the numerous metals used in laptops. The risks are listed by country, in alphabetical order.

The **oil** used to manufacture the plastics used in laptops is extracted in a number of places around the world with very limited traceability. Oil extraction is linked to environmental and social risks in Saudi Arabia, Russia, United Arab Emirates and Nigeria, including lack of union rights, poor working conditions and forced labour as well as oil spills leading to health impacts and contamination of soil and water for surrounding communities.[241] Oil extraction in high-risk environments has also been linked to sexual exploitation and abuse of women in surrounding areas.[242]

Mining is one of the most high-risk sectors in the world and in most countries, mining remains the most hazardous occupations when the number of people exposed to risk is taken into account.[243] Mining extraction in high-risk environments has also been linked to sexual exploitation and abuse of women in surrounding areas.[244] Mines require a high level of water use and quite a few of the

[236] Globalisation Monitoring, The Chinese Battery Industry: The Truth behind the Charge, 2012
[237] Human Rights Monitor South Korea, 56th death of former Samsung employee from occupational disease, Accessed April 2018
[238] List of Goods Produced by Child Labor or Forced Labor, Retrieved 2017-12-18
[239] China Labour Bulletin, Migrant workers and their children, Retrieved 2017-11-30
[240] International Trade Union Confederation, Global reach of Samsung's medieval practices revealed in new report, 5 October 2016
[241] Utrikesdepartementet, Mänskliga rättigheter i Saudiarabien 2011, Retrieved 2017-10-27; ILO, Working Paper No. 267, Working conditions of contract workers in the oil and gas industries, 2010; The Degradation of Work, Oil and Casualization of Labor in the Niger Delta, 2010; Oil price.com, Nigerian Oil Workers Go On Strike, Stop Production At Several Flow Stations, 2017; The Guardian, Shell Nigeria oil spill '60 times bigger than claimed', 2012-04-23
[242]Wday, The Bakken's dirty secret: sex trafficking has growing precense in oil patch experts say 2014-05-06, Al Jazeera, The Dark side of the oil boom: Human trafficking in the Heartland, 2014-04-28, Columbia law school, Righting wrongs? Barrick Gold's remedy mechanism for sexual violence in Papua New Guinea November 2015
[243] ILO, Mining: A Hazardous work, Retrieved 2017-11-28
[244]Wday, The Bakken's dirty secret: sex trafficking has growing precense in oil patch experts say 2014-05-06, Al Jazeera, The Dark side of the oil boom: Human trafficking in the Heartland, 2014-04-28, Columbia law school, Righting wrongs? Barrick Gold's remedy mechanism for sexual violence in Papua New Guinea November 2015

countries listed below have areas where there is a risk of water shortage.[245] Mining often produces toxic waste products and airborne pollutants that are harmful to human health. Heavy metals such as arsenic and cadmium can induce multiple organ damage, even at lower levels of exposure.[246] Many metals are energy intensive to produce and therefore associated with high levels of CO_2 emissions. Low recycling rates are an issue. For example, cobalt consumption is expected to exceed production by 2020, and gold may become unavailable from mining within 100 years.[247]

In **Argentina,** lithium mining is linked to land grabbing and forcible relocation of indigenous communities off their land.[248]

The mining industry in general in **Brazil** has been accused of throwing people off their land and having an extremely poor health and safety record.[249]

In **Chile,** lithium mining is associated with land grabbing and the displacement of indigenous people off their land.[250] Silver mining is linked to water pollution, land controversies, killings of protestors, and failure to respect indigenous peoples' rights.[251] The extraction and processing of silver requires chemicals such as cyanide and mercury. Both can be harmful to humans and the environment. If not managed properly, exposure to mercury can damage the central nervous system and the kidneys.[252] Copper mining is associated with depletion of water resources in the Atacama desert, air pollution and respiratory problems. [253]

China provides more of the minerals used in phones than any other country. These include aluminium, antimony, arsenic, cadmium, gallium, gold, indium, lead, magnesium, phosphate, rare-earth metals, silicon, silver, tin, tungsten and zinc.

China's mining industry has a poor safety record. The industry is associated with severe environmental impacts, poor working conditions, and limited labour rights for workers. Lack of safety is a major problem, which has resulted in many deaths in the Chinese mining industry. [254] Greenpeace has documented contamination of water and land around Asia's largest zinc and lead mine and smelter in China. Emissions have impacted the health of the local communities. It is estimated that a third of all lead poisoning in China has been caused by smelting lead and zinc.[255]

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[245] World Resource Institute, Mine the Gap: Connecting Water Risks and Disclosure in the Mining Sector 2010
[246] US National Library of Medicine, Heavy metals toxicity and the environment, 26 August 2014
[247] Fairphone, Smartphone material profile, 2017
[248] Todd Frankel and Peter Whoriskey, Tossed Aside In The 'White Gold' Rush, Retrieved 2017-11-1
[249] Mining.com, Report investigates human rights abuse linked to Kinross Gold's Brazilian mine, 11 December 2017; International Federation for Human Rights, How much are human rights worth in the Brazilian mining and steel industry?, 18 May 2011
[250] Todd Frankel and Peter Whoriskey, Tossed Aside In The 'White Gold' Rush, Retrieved 2017-11-1
[251] Telesur, Canadian Mining Giant Violently Evicts Villagers in Mexico, 2017-01-31, The Guardian, The Canadian company mining hills of silver – and the people dying to stop it, 2017-07-13, Observatorio de Conflictos Mineros en América Latina, Juan Claro, Julio Ponce y Pascua Lama, algunos de los casos más polémicos que esperan decisiones clave del Tribunal Ambiental, 2017-09-13
252 Enact Sustainable Strategies, Riskanalys: Förband och sårvård, 2017
[253] Fairphone, Smartphone material profile, 2017
[254] US Geological Survey, 2013 Minerals Yearbook, China; Mining Technology, China's appalling mining death rate – dealing with 'disorderly' management 2012-10-31
[255] Greenpeace, Investigation finds pollution and illness ignored at Asia's largest lead mine, Yunnan Province 2015-06-09

China has imposed stricter environmental regulations on bauxite (aluminium) smelters, forcing some to shut down.[256] Bauxite mining in China has social and environmental impacts. Bauxite is extracted from open mine pits, which can cause leaching of toxic substances, dust and water pollution, soil erosion, water shortage and negative impacts on biodiversity.[257] Other risks associated with the countries involved are: lack of union rights and harassment of unionised workers, in some cases conflicts connected to local communities and indigenous peoples' land rights, low wages, poor working conditions and sometimes child labour and forced labour.[258] Chinese mine sites have been found to rely on large numbers of migrant workers, who receive less pay and often work without personal protection equipment.[259]

There have been large-scale spillages of toxic "red mud" waste reportedly linked to bauxite (aluminium and gallium) mining and processing due to poor storage and tailing dams overflowing – causing environmental degradation, displacement of communities and reported mortalities. Many mines were closed in 2016 due to widespread water and soil contamination and risks to public health.[260]

Gold is a fast-growing industry in China, often leading to inadequate infrastructure that is associated with poor health and safety in underground mines, high risk of respiratory disease (silicosis), toxic water and soil contamination. [261]

There is evidence of soil and water contamination by heavy metals, particularly cadmium and lead, in zinc/lead mining and processing regions.[262]

The mining of rare earths has caused the contamination of farmland and the creation of toxic lakes in Inner Mongolia. Air pollution is linked to respiratory illness, skin diseases and cancer. Artisanal and small-scale mining has contributed to these negative effects, prompting a crackdown on unregulated activity and a tightening of environmental regulations.[263]

In the tin mining sector artisanal and small-scale production is associated with a high incidence of respiratory disease, especially silicosis. [264]

Tungsten mining is linked to the destruction of UNESCO-protected forests in Yunnan province.[265]

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[256] Reuters, Alumina shortages to increase as Chinese crackdown bites, 2017-10-19; Industrial Minerals, Environmental tax to end era of cheap Chinese minerals, 2017-06-30; Asociación Nacional de Fabricantes de Productos Refractarios, Materiales y Servicios Afines, Massive production shutdown in China lifts bauxite prices, 2017-06-05

[257] The Wilderness Society, Bauxite mining threatens Wild Rivers 2015-07-31; Naturskyddsföreningen, Bra Miljöval – Kriterier 2013:4 2013

[258] Swedwatch, Riskanalys av material och leverantörsled i Kungsbrohuset 2011; SVT, Brasilien: Indianer ockuperar gruva, 2006-10-19, Business & Human Rights Resource Center, Business and Human Rights in Guinea Retrieved 2017-10-27

[259] Enact Sustainable Strategies, Riskanalys: instrument, 2017

[260] Fairphone, Smartphone material profile, 2017

[261] Fairphone, Smartphone material profile, 2017

[262] Fairphone, Smartphone material profile, 2017

[263] Fairphone, Smartphone material profile, 2017

[264] Fairphone, Smartphone material profile, 2017

[265] Fairphone, Smartphone material profile, 2017

For the mining of indium, there is a risk that inadequate storage facilities leads to toxic heavy metals leaching into the environment if not adequately managed and stored. [266]

There is a high risk of the worst forms of human rights abuses in the mining industry in the **Democratic Republic of Congo (DRC)**. DRC is the largest supplier of cobalt in the world, and child labour, forced labour, the forced relocation of local communities, bribery and deplorable working conditions are reported.[267] There is evidence that cobalt is used to finance armed groups in the DRC, and is currently under consideration as a fifth conflict mineral (in addition to gold, tantalum, tin and tungsten). [268] Mining communities are exposed to dangerous levels of contaminated dust and water.[269]

The mining of tantalum in the DRC is also associated with high levels of child labour, forced labour, a high risk of serious health impacts on nearby communities and loss of habitat for a critical endangered gorilla.[270] Tantalum is a designated as being a "conflict mineral" due to its association with the funding of armed groups in the DRC meaning that, from 2012, EU companies will be required to source tantalum from responsible, conflict-free areas.[271]

In **Indonesia,** 6,300 children work in the informal tin mining sector, 30% of them aged 14 or less.[272] There is a severe risk of environmental issues associated with tin mining, especially in marine areas where seabed mining sometimes takes place. Some of the mining is carried out by artisanal miners where there is a high risk of health and safety issues including respiratory diseases.[273]

10% of **Morocco**'s phosphate production comes from Western Sahara.[274] The status of Western Sahara is a disputed territory, claimed by both Morocco and a Sahrawi liberation movement. Some of it is administered by Morocco and some by Polisario, the liberation movement. No country recognises Morocco's annexation of Western Sahara.

A majority of the tin from **Myanmar** comes from the de-facto autonomous Wa state [275] which is run by the United Wa State Army, an insurgent group that the US government lists as a significant producer of methamphetamines[276] and, until recently, considered to be one of the largest heroin producing and trafficking organisations in the world.[277] Large-scale industrial tin mining projects in Myanmar have had a severe impact on local ecosystems. Two mines were closed in 2016 for failing to uphold environmental regulation after villagers filed a lawsuit for water and soil pollution, degradation of farmland, reduced biodiversity and risks to public health. [278]

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[266] Fairphone, Smartphone material profile, 2017
[267] Todd Frankel, The Cobalt Pipeline,The Washington Post, Retrieved 2017-10-31; Todd Frankel, The Cobalt Pipeline,The Washington Post, Retrieved 2017-10-31; Fairphone, Smartphone material profile, 2017
[268] Fairphone, Smartphone material profile, 2017
[269] Fairphone, Smartphone material profile, 2017
[270] Fairphone, Smartphone material profile, 2017
[271] European Commission, Conflict minerals: the regulation explained, Accessed April 2018
[272] K4D, Overview of child labour in the artisanal and small-scale mining sector in Asia and Africa, 4 October 2017
[273] Fairphone, Smartphone material profile, 2017
[274] Western Sahara Resource Watch, The phosphate exports, 29 July 2007
[275] Fairphone, Smartphone material profile, 2017
[276] US Department of State, International narcotics control strategy report, March 2017
[277] US Drug Enforcement Administration, Eight High-Ranking Leaders Of Southeast Asia's Largest Narcotics Trafficking Organization Indicted By A Federal Grand Jury In Brooklyn, New York, 24 January 2005
[278] Fairphone, Smartphone material profile, 2017

New Caledonia is an overseas territory of France. It is due to hold a referendum on independence in November 2018. Nickel mining there is associated with water pollution, deforestation, biodiversity loss and the pollution and destruction of coral reefs.[279]

In the **Phillippines**, the mining of nickel is linked to human rights and environmental impacts. The Philippines is one of the most dangerous countries for anti-mining activists, especially indigenous peoples' activists, and mining has caused conflict over land, particularly where Free, Prior and Informed Consent has not been obtained.[280]

Peru's Human Rights Ombudsman lists industrial mining as bring the top cause of conflict in the country due to environmental concerns and lack of job generation. Copper mining has doubled in the last five years, leading to the depletion of water resources in the Andes. There was sharp rise in violent conflict in 2015 which is linked to copper mining. Several protesters have been killed by police.[281] Copper mining is linked to the production of toxic waste which can damage surrounding land, water, animals and plants.[282] Zinc mining is linked to water pollution and water shortages, anti-union activities and land conflicts impacting local communities.[283]

In **Russia**, the mining of nickel is linked to human rights and environmental impacts.[284] There has been an increase in the amount of gold dredging in Russia as a result of the ban on dredge mining in China. Gold dredging is associated with mercury contamination in Russia.[285]

In **Rwanda**, tantalum mining is usually carried out by artisanal and small-scale miners. It is associated with child labour and tax avoidance. Much of the tantalum is labelled as coming from Rwanda actually comes from the DRC.[286]

In **South Africa,** mining in general is associated with health and safety issues.[287]

In **Ukraine**, there have been large-scale spillages of toxic "red mud" waste reportedly linked to bauxite (aluminium and gallium) mining and processing due to poor storage and tailing dams overflowing – causing environmental degradation, displacement of communities and reported mortalities.[288]

Monitors

Summary of the most severe risks

Assembly	Components	Raw materials

[279] Fairphone, Smartphone material profile, 2017
[280] Fairphone, Smartphone material profile, 2017
[281] Fairphone, Smartphone material profile, 2017
[282] Global Policy, From the ore to the car - summary, University of Virginia, Copper Mining from the ground up Retrieved 2017-11-17
[283] Swedwatch, Rena guldgruvan AP-fondernas investeringar har en smutsig baksida 2011
[284] Fairphone, Smartphone material profile, 2017
[285] Fairphone, Smartphone material profile, 2017
[286] Fairphone, Smartphone material profile, 2017
[287] Mining in Africa, Mining conditions in South Africa, Accessed April 2018
[288] Fairphone, Smartphone material profile, 2017

Forced overtime Low pay Trade union rights not respected Underage labour[289]	Forced overtime Low pay Health and safety issues, including people possibly dying from exposure to chemicals Trade union rights not respected Underage labour[290]	Severe environmental impacts Severe health and safety issues Killing of protestors Land grabbing Trade union rights not respected
Medium-high risk	**High risk**	**High risk**

The product

Monitors are made from:

- A screen which comprises liquid crystal display (LCD) backlit with LED lights.[291] It is made from glass coated with a very thin layer of indium tin oxide. [292] The front of the screen can be either glass or plastic.[293]
- Circuitry that is primarily made from copper, gold and silver but also contain micro-capacitors which use tantalum, platinum, palladium, tungsten, niobium and rare earths, and resistors which are made of ceramic which is made aluminium oxide.[294] The metals are mounted onto a board made of epoxy resin and fibreglass.[295]
- Solder, to join the various parts of the monitor together, usually made from an alloy of tin, silver and copper.[296] Lead is banned from consumer electronics in the EU.[297]

[289] The term 'underage labour' is used to mean 16 and 17 year olds working illegally. It is used to distinguish it from the worst forms of child labour involving younger children.
[290] The term 'underage labour' is used to mean 16 and 17 year olds working illegally. It is used to distinguish it from the worst forms of child labour involving younger children.
[291] Laptopscreen, Is my screen LED or LCD, 14 November 2014
[292] Quora.com, What is a computer screen made of, 23 March 2017; Techwalla, What Elements Are Used in Laptops?, Accessed April 2018
[293] Quora.com, What is a computer screen made of, 23 March 2017
[294] Minerals Education Coalition, What's in my cell phone?, Accessed March 2018; Minerals Education Coalition, Cell phone minerals, Accessed March 2018; US Geological Service, Recycled Cell Phones—A Treasure Trove of Valuable Metals, July 2006; The East African, Minerals in your mobile phone, 4 June 2015;; American Chemical Society, Smartphones: smart chemistry, Accessed March 2018; Fairphone, Smartphone material profile, 2017; Techwalla, What Elements Are Used in Laptops?, Accessed April 2018
[295] Musterkids, Mobile phone manufacturing, Accessed March 2018; MusterKids, Mobile phone resources, Accessed March 2018; Techwalla, What Materials Are Used to Make Cell Phones?, Accessed March 2018
[296] MusterKids, Mobile phone resources, Accessed March 2018; Techradar, The weird and wonderful materials that make up your PC, 22 July 2012
[297] European Commission, Environment: EU ban on hazardous substances in electrical and electronic products takes effect, 30 June 2006

- A casing which is made of plastic.

The supply chain

Norway imports most (72%) of its computer monitors from China.[298] 4% come from Thailand, 4% from Sweden, 4% from the Republic of Korea and 3% from Japan. No other single country makes up more than 2% of the imports. It is likely that the monitors imported from Sweden are re-imports from elsewhere.

Top-selling brands of computer monitor in Norway[299] are manufactured by Taiwanese or South Korean multinationals. One of the big brands has products that are assembled in Taiwan, with suppliers located primarily in Taiwan and China, as well as Malaysia, Thailand, the Philippines, Indonesia, Vietnam, India, Brazil and Hungary.[300] Another big brand has factories in South Korea, China and the US.[301] Another big brand does not make any information on its supply chain public on its website, and has been criticised by Ethical Consumer for this,[302] though an archive of one of its webpages shows that it has factories in China, Brazil and Europe.[303]

Assembly	**Components**	**Raw Materials**[304]
China Thailand South Korea Japan	China Taiwan South Korea USA Malaysia Thailand The Philippines Indonesia Vietnam India Brazil	**Aluminium**: China[305] **Copper**: Chile, Peru[306] **Gold**: China, Australia, Russia[307] **Indium**: China, South Korea[308] **Niobium:** Brazil[309] **Palladium**: Russia, South Africa[310] **Plastic, from oil and gas**: Saudi Arabia, Russia, United Arab Emirates, Canada, Nigeria (oil); and Qatar, Norway, United States (gas)

[298] Lifewire, Where is the iPhone made?, 13 October 2017
[299] Komplett, Touch-skjermer, Accessed April 2018; Komplett, Skjermer, Accessed April 2018
[300] Acer, Our supply chain, Accessed April 2018
[301] Samsung, Manufacturing centers, Accessed April 2018
[302] Ethical Consumer, TPV Technology, Accessed April 2018
[303] AOC India, archived web page, TVP Worldwide, Accessed April 2018
[304] All countries that produce 10% or more of global production listed
[305] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[306] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[307] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018. No single country produces more than 10% of the world's supply of gold; the top three producing countries are included here
[308] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[309] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[310] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018

	Hungary and elsewhere in Europe	**Platinum**: South Africa, Russia[311] **Rare-earth metals[312]:** China, Australia[313] **Silicon**: China[314] **Silver**: Mexico, Peru, China[315] **Tantalum**: Rwanda, DR Congo, Nigeria[316] **Tin**: China, Indonesia, Myanmar[317] **Tungsten**: China[318]

Risks

Assembly

Most computer monitors are assembled in China where there is a high risk of human rights abuses in factories including child labour[319] and forced and bonded labour.[320] Health and safety conditions are poor.[321] There is a risk that people are paid very low wages and/or required to work excessively long hours or be forced to work overtime.[322] Migrant workers constitute a particularly vulnerable group, in which individuals risk being exploited and often lack proper contracts and access to social security.[323] Trade union rights are not respected in China as the state does not allow independent trade unions.[324]

[311] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[312] An iPhone contains eight different rare-earth metals. Across several varieties of smartphones there are 16 of the 17 rare earth metals. The only one you will not find is promethium, which is radioactive. American Chemical Society, Smartphones: smart chemistry, Accessed March 2018
[313] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[314] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[315] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[316] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[317] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[318] US Geological Survey, Mineral commodity summaries 2018, Accessed March 2018
[319] China Labor Watch, reports on toy factories in China, Retrieved 2017-11-02; International Labor Rights Forum, Six cents an hour, 1996
[320] Topical research digest: Human rights and contemporary slavery, The dark side of labour in China, Retrieved 2017-11-02
[321] International Journal of Occupational and Environmental Health, Occupational Health and Safety in China, Oct/Dec 2003; Labor Watch Pakistan, Safety at workplace, 2015-08-24
[322] South China Morning Post, 'Low pay, long hours': life inside factory that supplied Ivanka Trump brand in China, 2017-06-28; The Guardian, The grim truth of Chinese factories producing the west's Christmas toys, 2016-12-04; China Labor Watch, Minimum wage standards in China, 2016; International Labor Rights Forum, Six cents an hour, 1996
[323] China Labour Bulletin, Migrant workers and their children, Retrieved 2017-11-30
[324] ITUC, Survey of violations of trade union rights in China, 2016-2017

There are reports that one major manufacturer of monitors has policies to discourage trade union membership, of workers committing suicide to protest against poor working conditions and of health and safety issues.[325] A report by the International Trade Union Federation references a worker safety group which it says documented more than 200 cases of serious illnesses, including leukaemia, lupus, lymphoma, multiple sclerosis and brain tumours among former semiconductor and LCD workers. [326] Seventy-six workers have died, most in their 20s and 30s.[327] An Associated Press investigation found that, at the company's request, South Korean authorities withheld information about the chemicals people were exposed to from sick workers and bereaved families, citing trade secrets.[328]

Labour rights violations including poor wages and discrimination against pregnant women have been documented at a factory for a major brand of monitors in Thailand. [329] 18 trade union leaders were dismissed from their jobs there in 2007 (but were later reinstated after an NGO and trade union campaign).[330]

In Thailand, labour rights activists and migrant workers have been prosecuted for reporting persecution.[331] There are approximately two million migrants workers in Thailand; they excluded from social and health services, and are denied the right to join a trade union.[332] Workers in electronics factories in Thailand and the Philippines said that the biggest challenges they faced were from having temporary contracts or being employed via agencies.[333]

Components

An investigation into labour rights at factories in China and the Philippines found long hours, low pay and poor health and safety at factories making parts for major brands of monitor.[334] Former workers for factories supplying a wide range of monitor manufacturers report lack of personal protective equipment when dealing with dangerous chemicals; the health of several workers has been damaged.[335]

It is likely that the findings of investigations into labour rights in laptop supply companies apply equally to companies supplying parts for monitors. For example, an investigation by SOMO found labour rights violations at factories in the Philippines that supply two well-known companies that sell laptops and monitors, including mandatory 12 hours days, forced overtime and unrecognized rights

[325] International Trade Union Confederation, Global reach of Samsung's medieval practices revealed in new report, 5 October 2016
[326] International Trade Union Confederation, Global reach of Samsung's medieval practices revealed in new report, 5 October 2016
[327] Al Jazeera, Report: Samsung endangered workers health in S Korea, 10 August 2016
[328] Associated Press, 2 words keep sick Samsung workers from data: trade secrets, 11 August 2016; Al Jazeera, Report: Samsung endangered workers health in S Korea, 10 August 2016
[329] SOMO, Sony reinstates Thai Union leaders, 3 October 2007
[330] SOMO, Sony reinstates Thai Union leaders, 3 October 2007
[331] International Labor Rights Forum, Migrant workers prosecuted for reporting exploitation in Thailand, 19 September 2017
[332] GoodElectronics, Labour issues in the Thai electronics industry, 4 April 2012
[333] SOMO, Workers' rights in the global electronics sector, November 2012
[334] SOMO, Acer and Fujitsu Siemens Computers irresponsible, 10 December 2005; SOMO, Acer Incorporated, 1 December 2005
[335] SOMO, Report reveals victim stories of chemical poisoning in electronics industry in China, 5 September 2016

to form labour unions.[336] A Chinese factory making parts for three well-known companies that sell laptops and monitors has been found to require student interns as young as 16 to work 12 hour days in order to receive their diploma.[337]

Health and safety is an issue in the manufacturing of electronics as they require handling a large number of chemicals. If personal protective gear and other safety measures is not used, or is insufficient, workers could be exposed to hazardous fumes and toxic chemicals[338] which can cause cancer, skin burns and eye damage as well as other reactions and diseases.[339] South Korea Human Rights Monitor has documented has documented issues around occupational health and safety, including numerous cases of young workers dying, apparently as a result of exposure to chemicals.[340]

In general, forced labour and child labour are reported from the electronics industry in China.[341] Migrant workers constitute a large share of the workforce in the manufacturing sector in both China and South Korea, and are in general more at risk of exploitation and discrimination. In China, migrant workers from rural areas often lack contracts and access to social security and are forced to leave their children behind with family as they often do not have the means to support them.[342]

Most of the major electronics brands have factories or suppliers in Central and East European countries, including Hungary, where MakeITFair has documented issues with the highly insecure work carried out by agency workers.[343]

There are no guarantees of trade union rights being respected in many of the countries which make the components for monitors: China, South Korea, the Philippines, Indonesia, Vietnam and India.[344]

Raw materials

This section first lists the risks related to oil and gas and then lists the risks associated with mining and smelting the numerous metals used in monitors. The risks are listed by country, in alphabetical order.

The **oil** used to manufacture the plastics used in monitors is extracted in a number of places around the world with very limited traceability. Oil extraction is linked to environmental and social risks in Saudi Arabia, Russia, United Arab Emirates and Nigeria, including lack of union rights, poor working conditions and forced labour as well as oil spills leading to health impacts and contamination of soil

[336] SOMO, CSR behaviour of MNO's in global ICT supply chain Philippines, 1 April 2005
[337] The Guardian, Chinese factory supplying major laptop brands accused of student labour abuses, 6 October 2017
[338] United States Department of Labor, Battery manufacturing, 2017-11-30
[339] Globalisation Monitoring, The Chinese Battery Industry: The Truth behind the Charge, 2012
[340] Human Rights Monitor South Korea, 56th death of former Samsung employee from occupational disease, Accessed April 2018
[341] List of Goods Produced by Child Labor or Forced Labor, Retrieved 2017-12-18
[342] China Labour Bulletin, Migrant workers and their children, Retrieved 2017-11-30
[343] GoodElectronics, 'On the move. The electronics industry in Central and Eastern Europe', by makeITfair, 14 December 2009
[344] ITUC, Survey of violations of trade union rights, Accessed April 2018

and water for surrounding communities.[345] Oil extraction in high-risk environments has also been linked to sexual exploitation and abuse of women in surrounding areas.[346]

Mining is one of the most high-risk sectors in the world and in most countries, mining remains the most hazardous occupations when the number of people exposed to risk is taken into account.[347] Mining extraction in high-risk environments has also been linked to sexual exploitation and abuse of women in surrounding areas.[348] Mines require a high level of water use and quite a few of the countries listed below have areas where there is a risk of water shortage.[349] Mining often produces toxic waste products and airborne pollutants that are harmful to human health. Many metals are energy intensive to produce and therefore associated with high levels of CO_2 emissions. Low recycling rates are an issue. For example, gold may become unavailable from mining within 100 years.[350]

The mining industry in general in **Brazil** has been accused of throwing people off their land and having an extremely poor health and safety record.[351]

In **Chile,** lithium mining is associated with land grabbing and the displacement of indigenous people off their land.[352] Silver mining is linked to water pollution, land controversies, killings of protestors, and failure to respect indigenous peoples' rights.[353] The extraction and processing of silver requires chemicals such as cyanide and mercury. Both can be harmful to humans and the environment. If not managed properly, exposure to mercury can damage the central nervous system and the kidneys.[354] Copper mining is associated with depletion of water resources in the Atacama desert, air pollution and respiratory problems. [355]

China provides more of the minerals used in monitors than any other country. These include aluminium, gold, indium, rare-earth metals, silicon and silver.

China's mining industry has a poor safety record. The industry is associated with severe environmental impacts, poor working conditions, and limited labour rights for workers. Lack of safety

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[345] Utrikesdepartementet, Mänskliga rättigheter i Saudiarabien 2011, Retrieved 2017-10-27; ILO, Working Paper No. 267, Working conditions of contract workers in the oil and gas industries, 2010; The Degradation of Work, Oil and Casualization of Labor in the Niger Delta, 2010; Oil price.com, Nigerian Oil Workers Go On Strike, Stop Production At Several Flow Stations, 2017; The Guardian, Shell Nigeria oil spill '60 times bigger than claimed', 2012-04-23

[346]Wday, The Bakken's dirty secret: sex trafficking has growing precense in oil patch experts say 2014-05-06, Al Jazeera, The Dark side of the oil boom: Human trafficking in the Heartland, 2014-04-28, Columbia law school, Righting wrongs? Barrick Gold's remedy mechanism for sexual violence in Papua New Guinea November 2015

[347] ILO, Mining: A Hazardous work, Retrieved 2017-11-28

[348]Wday, The Bakken's dirty secret: sex trafficking has growing precense in oil patch experts say 2014-05-06, Al Jazeera, The Dark side of the oil boom: Human trafficking in the Heartland, 2014-04-28, Columbia law school, Righting wrongs? Barrick Gold's remedy mechanism for sexual violence in Papua New Guinea November 2015

[349] World Resource Institute, Mine the Gap: Connecting Water Risks and Disclosure in the Mining Sector 2010

[350] Fairphone, Smartphone material profile, 2017

[351] Mining.com, Report investigates human rights abuse linked to Kinross Gold's Brazilian mine, 11 December 2017; International Federation for Human Rights, How much are human rights worth in the Brazilian mining and steel industry?, 18 May 2011

[352] Todd Frankel and Peter Whoriskey, Tossed Aside In The 'White Gold' Rush, Retrieved 2017-11-1

[353] Telesur, Canadian Mining Giant Violently Evicts Villagers in Mexico, 2017-01-31, The Guardian, The Canadian company mining hills of silver – and the people dying to stop it, 2017-07-13, Observatorio de Conflictos Mineros en América Latina, Juan Claro, Julio Ponce y Pascua Lama, algunos de los casos más polémicos que esperan decisiones clave del Tribunal Ambiental, 2017-09-13

354 Enact Sustainable Strategies, Riskanalys: Förband och sårvård, 2017

[355] Fairphone, Smartphone material profile, 2017

is a major problem, which has resulted in many deaths in the Chinese mining industry. [356] Greenpeace has documented contamination of water and land around Asia's largest zinc and lead mine and smelter in China. Emissions have impacted the health of the local communities. It is estimated that a third of all lead poisoning in China has been caused by smelting lead and zinc.[357]

China has imposed stricter environmental regulations on bauxite (aluminium) smelters, forcing some to shut down.[358] Bauxite mining in China has social and environmental impacts. Bauxite is extracted from open mine pits, which can cause leaching of toxic substances, dust and water pollution, soil erosion, water shortage and negative impacts on biodiversity.[359] Other risks associated with the countries involved are: lack of union rights and harassment of unionised workers, in some cases conflicts connected to local communities and indigenous peoples' land rights, low wages, poor working conditions and sometimes child labour and forced labour.[360] Chinese mine sites have been found to rely on large numbers of migrant workers, who receive less pay and often work without personal protection equipment.[361]

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[356] US Geological Survey, 2013 Minerals Yearbook, China; Mining Technology, China's appalling mining death rate – dealing with 'disorderly' management 2012-10-31

[357] Greenpeace, Investigation finds pollution and illness ignored at Asia's largest lead mine, Yunnan Province 2015-06-09

[358] Reuters, Alumina shortages to increase as Chinese crackdown bites, 2017-10-19; Industrial Minerals, Environmental tax to end era of cheap Chinese minerals, 2017-06-30; Asociación Nacional de Fabricantes de Productos Refractarios, Materiales y Servicios Afines, Massive production shutdown in China lifts bauxite prices, 2017-06-05

[359] The Wilderness Society, Bauxite mining threatens Wild Rivers 2015-07-31; Naturskyddsföreningen, Bra Miljöval – Kriterier 2013:4 2013

[360] Swedwatch, Riskanalys av material och leverantörsled i Kungsbrohuset 2011; SVT, Brasilien: Indianer ockuperar gruva, 2006-10-19, Business & Human Rights Resource Center, Business and Human Rights in Guinea Retrieved 2017-10-27

[361] Enact Sustainable Strategies, Riskanalys: instrument, 2017

[362] Fairphone, Smartphone material profile, 2017

[363] Fairphone, Smartphone material profile, 2017

[364] Fairphone, Smartphone material profile, 2017

[365] Fairphone, Smartphone material profile, 2017

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[366] Fairphone, Smartphone material profile, 2017
[367] Global Policy, From the ore to the car - summary, University of Virginia, Copper Mining from the ground up Retrieved 2017-11-17
[368] Swedwatch, Rena guldgruvan AP-fondernas investeringar har en smutsig baksida 2011
[369] Mining in Africa, Mining conditions in South Africa, Accessed April 2018