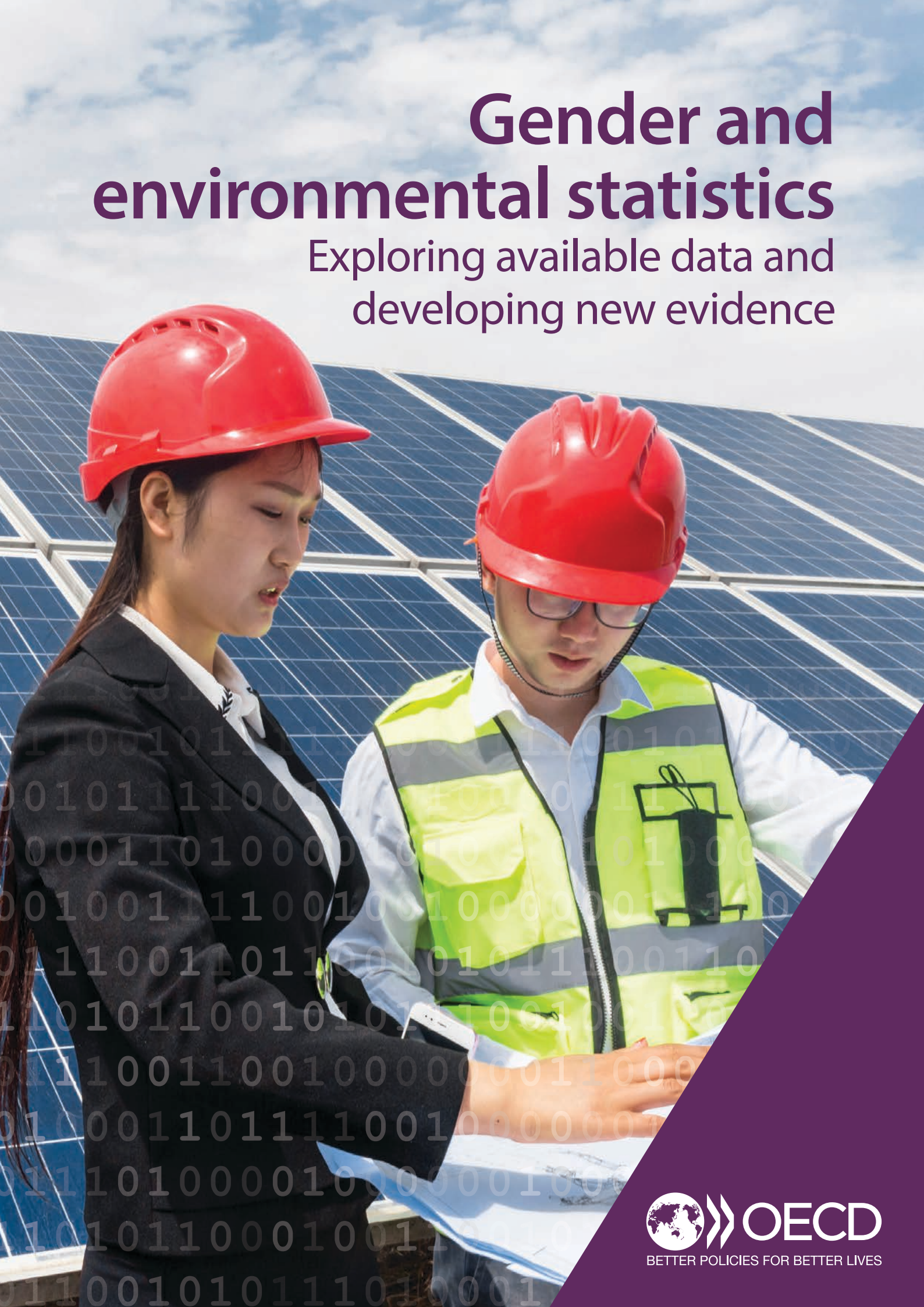
Gender and environmental statistics

Exploring available data and developing new evidence



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BETTER POLICIES FOR BETTER LIVES

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Contents

There is growing recognition of the need for a gender lens to understand the impact of environmental factors on well-being. On-going OECD work[1] has highlighted the gender divide in environmental quality and the ability to shape environmental outcomes. In many low-income countries, women experience greater exposure to indoor air pollution from solid fuel use, increased harm from poor sanitation, higher exposure to toxic chemicals in occupations (e.g. textiles industry), and – in general – greater vulnerability to climate change, biodiversity loss, and ecosystem damage. In advanced economies, there are differences in exposure to pollution and hazardous chemicals between men and women, linked to consumption habits, physiological differences and gaps in socioeconomic backgrounds. In addition, around the world, women's ability to shape environmental choices is handicapped by legal, cultural and social constraints of different intensity.

However, the gender-specific outcomes of environmental policies are rarely considered and as a consequence, little gender-specific environmental data is collected by national statistical systems and environment agencies in OECD countries. According to an on-going survey[2] only seven OECD countries collect gender-disaggregated data related to the environment or environmental policy-making and thirteen countries consider gender aspects in environmental policy-making.

This brochure explores some of the available data and discusses opportunities to develop new evidence in an effort to better tackle the gender data gap and its associated policy implications. It presents:

- Initial results from an effort to explicitly develop the gender dimension in the domain of environment-related innovation;
- Evidence of differences between men and women in environment-related attitudes and behaviours;
- Initial findings on the variation in environmental quality across different population 'groups';
- Key messages from a unique set of gender-differentiated data on health effects from exposure to environment-related risks across a large number of countries.

[1] OECD (forthcoming), *Gender and the Environment: Building the Evidence Base and Advancing Policy Actions to Achieve the SDGs*, OECD Publishing, Paris.
[2] Idem.

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Women's participation in technology development is rising fast...

A. Technology development (invention)

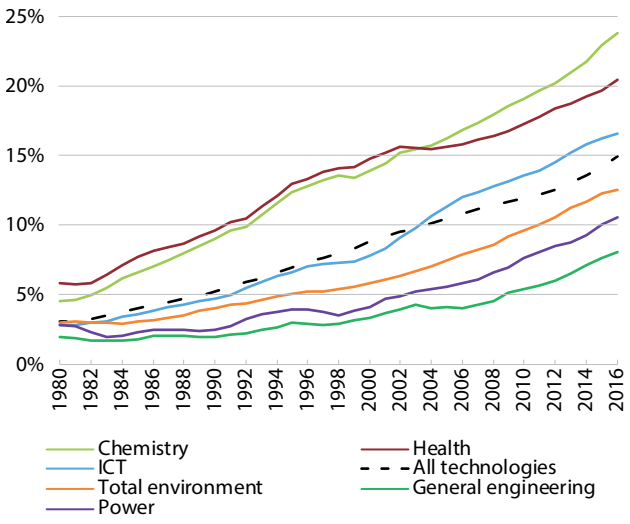
The share of women inventors has grown remarkably in many technology domains, as reflected in patent applications globally. Compared with 1980s, there are now four times more patents including at least one woman inventor, and five times more in the case of information and communication technologies (ICT).

Still, the gender gap remains significant. The percentage of women inventors remains low, reaching only 15% on average across all countries and all technology domains (Figure 1). There is a relatively higher participation observed for chemistry and health-related technologies (20% and 24% respectively), while environment-related technologies are just below the average participation, and the rate is even lower for power generation and general engineering technologies (10% and 8% respectively).

Differences in women's involvement across these domains could be explained by their traditionally rather low participation in science, technology, engineering and mathematics (STEM) courses, and this trend is likely to continue: the OECD (2020) PISA report shows that among students who score highly in the PISA tests, it is overwhelmingly boys who more often expect to work in science and engineering[3].

[3] OECD, "Dream Jobs? Teenagers' Career Aspirations and the Future of Work", *www.oecd.org/education/dream-jobs-teenagers-career-aspirations-and-the-future-of-work.htm*.

Figure 1. **The share of women inventors worldwide**



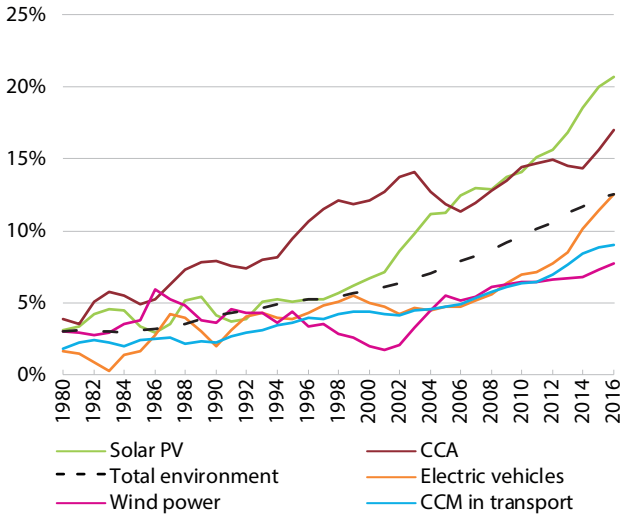
Note: Showing a 3-year moving average of counts of priority patent applications (simple patent families), by inventor's country of residence, with patent family size of two or more (claimed priorities). Data for 2016 are provisional. ICT = Information and Communication Technologies.
Source: OECD (2020), OECD Environment Statistics (database); OECD calculations based on extractions from EPO (2019) and using dictionairies from Lax Martínez et al. (2016) and search strategies developed by OECD.

...but their participation in developing green technologies has seen a smaller improvement

Developing new low-carbon and resource-efficient technologies is a prerequisite for achieving global climate and biodiversity goals. This requires drawing on the largest possible pool of talent globally. Excluding women from technology development efforts means ignoring the innovative capacity of half of humanity. Increased rates of women's participation in environmental innovation would help develop the local know-how which is required for a successful technology transfer across borders (e.g. from North to South) or domestically (e.g. from science and academia to industry and service sectors).

Environment-related technologies have seen a somewhat smaller improvement than the overall rate. However, there is important variation within the range of environment-related inventions both in levels and in their growth rates (Figure 2). Women's participation is higher in some of the relatively new domains such as climate change adaptation technologies and solar photovoltaics, which is in contrast to domains such as climate change mitigation technologies in transport and wind power with a persistently low rate of women inventors. The latter could be partly explained by the need for engineering skills for developing many transport and wind power technologies.

Figure 2. **Women's participation is higher in some of the less mature 'green' technologies,** *participation of women in inventions of environment-related technologies, worldwide*



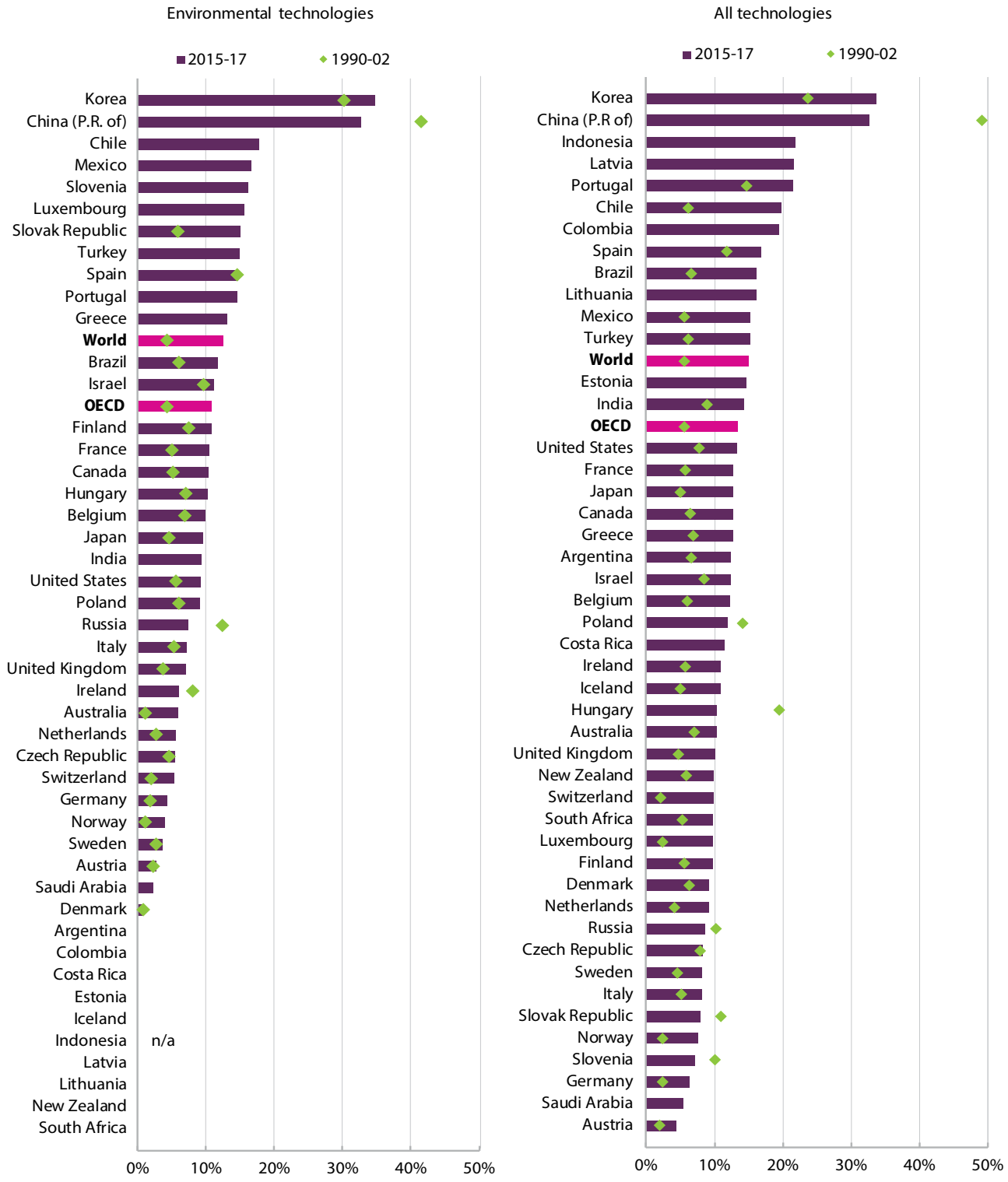
Note: Showing a 3-year moving average of counts of priority patent applications (simple patent families), by inventor's country of residence, with patent family size of two or more (claimed priorities). Data for 2016 are provisional. CCM = Climate Change Mitigation, CCA = Climate Change Adaptation.
Source: OECD (2020), OECD Environment Statistics (database); OECD calculations based on extractions from EPO (2019) and using dictionairies from Lax Martínez et al. (2016) and search strategies developed by OECD.

The share of women inventors in green technologies varies greatly across countries

At the country level, as many as a third of green inventions developed in Korea and the People's Republic of China (hereafter 'China') between 2015 and 2017 involved women, followed by Colombia (24%), Chile (18%) and Mexico (17%). In contrast, some of the countries which typically rank among the world's major contributors to green innovation, such as Japan, the United States and Germany (OECD 2017, Green Growth Indicators) all have women participation rates in developing green inventions of less than 10% (Figure 3). In countries such as Denmark, New Zealand and Iceland this is below 1%, even though these countries are traditional champions of women inclusion, and Denmark is also a leader in green innovation.

These results are broadly similar to those for all technologies. They are partly explained by the degree of technology specialisation in countries (e.g. Denmark and wind power) and the creation of new innovation hubs which might be more inclusive to women (while old structures and institutions may be difficult to reform). However, it is worth noting that most countries have seen important improvements in women inclusion in inventive activities – in environmental technologies and beyond.

Figure 3. **The share of women inventors varies greatly across countries,** *OECD and G20 countries*



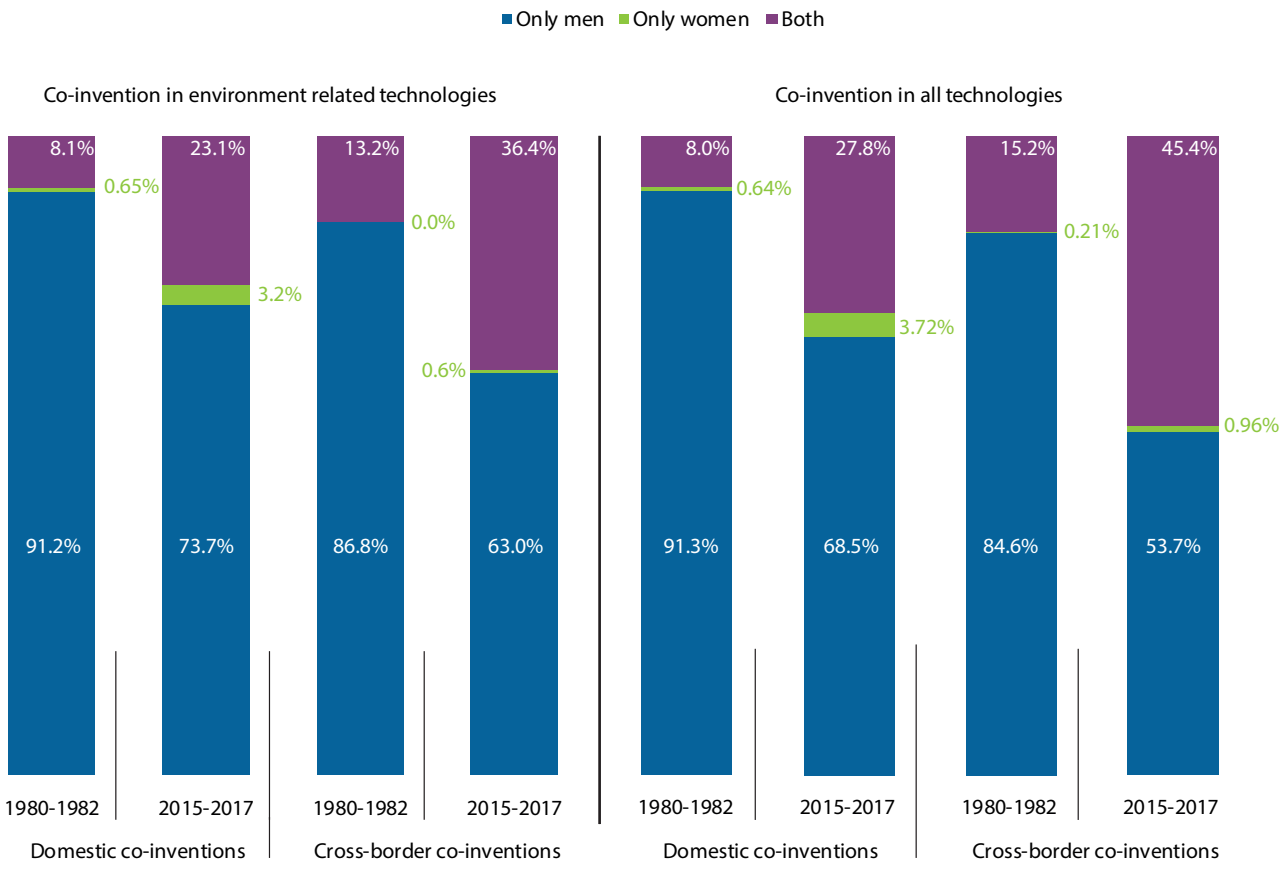
Note: Values based on less than 10 high-value inventions (claimed priorities) are not shown. Countries not meeting this threshold are shown as data not available (n/a).
Source: OECD (2020), OECD Environment Statistics (database); OECD calculations based on extractions from EPO (2019) and using dictionairies from Lax Martínez et al. (2016) and search strategies developed by OECD.

B. International collaboration in technology development (co-invention)

Encouraging inclusive and international collaboration in technology development is particularly pertinent when addressing public bads such as global climate change or regional water pollution. Worldwide, cross-border collaboration has become more common and more inclusive over time. Interestingly, inventions based on cross-border collaboration are more likely to include women than purely domestic inventions, in both environment-related technologies and technology in general (Figure 4). Overall, there have been steady improvements in the inclusion of women since 1980s, with almost a threefold increase in the share of inventions involving women.

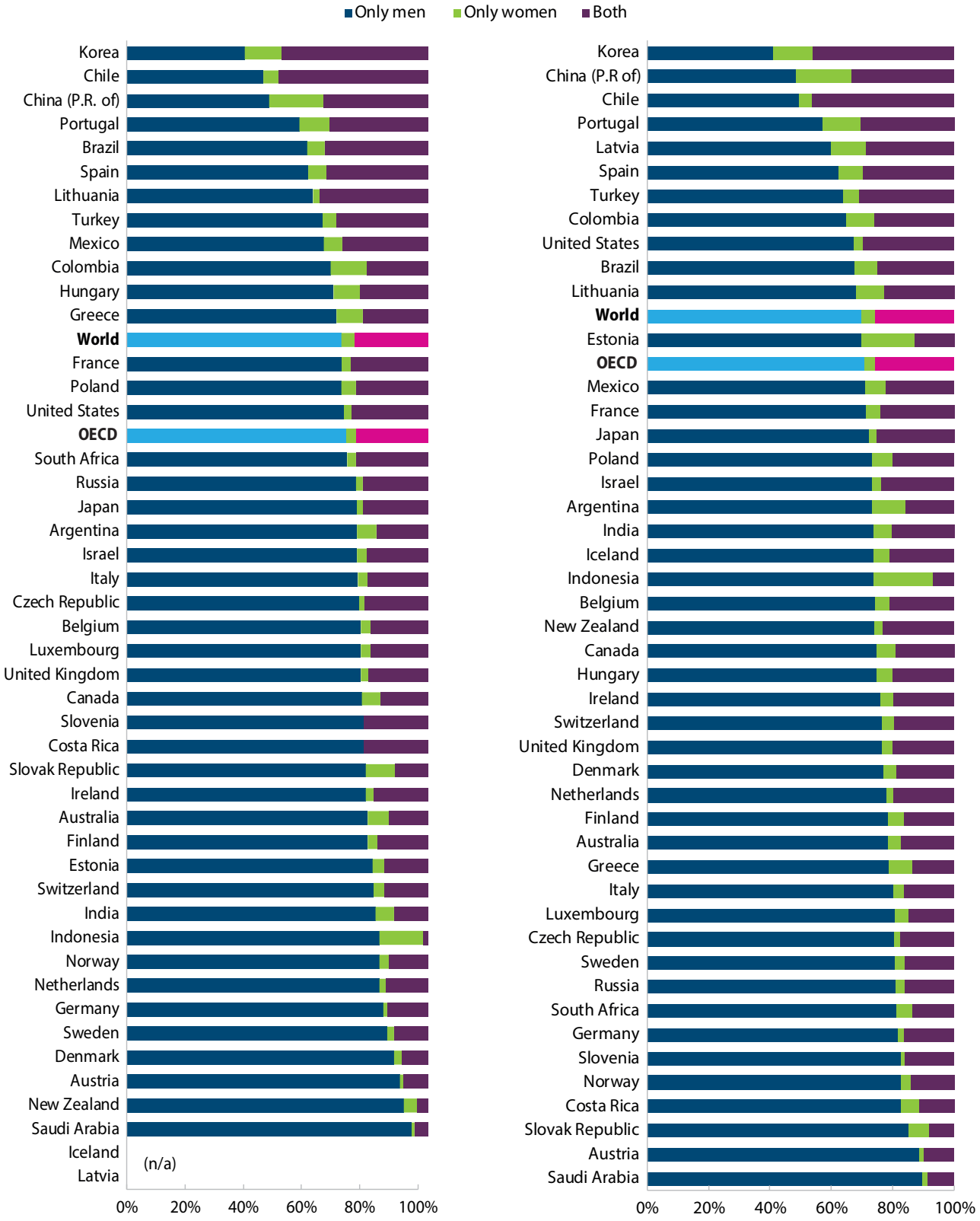
There is a large variation across countries in women's inclusion in collaboration for technology development (Figure 5). Overall, collaboration between groups of researchers including only men is the most common for green technologies. Korea, Chile and China are the only countries where women participate in more than half of all collaborative research. Interestingly, Indonesia is the only country where women-only collaboration is more common than mixed women-men collaboration; the same can be observed in Estonia but only for technology in general. Finally, countries such as Austria, New Zealand and Saudi Arabia show very low rates of women's participation in environment-related technology collaboration.

Figure 4. **Women participate more in cross-border research collaborations than domestic collaborations**



Source: OECD (2020) OECD Environment Statistics (database); OECD calculations based on extractions from EPO (2019) and using dictionairies from Lax Martínez et al. (2016) and search strategies developed by OECD.

Figure 5. **Women's participation in cross-border research collaboration is low in most countries**



Note: Only countries with at least 10 high-value inventions (claimed priorities) are shown. Countries not meeting this threshold are shown as data not available (n/a).
Source: OECD (2020) OECD Environment Statistics (database); OECD calculations based on extractions from EPO (2019) and using dictionairies from Lax Martínez et al. (2016) and search strategies developed by OECD.

C. Measurement

Identification of women inventors relies on the country-specific gender-name dictionaries developed in Lax Martínez et al. (2016). These dictionaries are subsequently applied to inventors' names listed in patent documents using a similarity matching algorithm. Statistics for Indonesia, China and Korea are preliminary since inventor names could only be gender-attributed in 65%, 70% and 80% of the cases, respectively. Patent statistics are shown only for countries with more than 10 high-value patent applications (defined as patent priorities registered in at least two jurisdictions which indicates higher expected market value). Patents are allocated to technology domains on the basis of the patent classification codes following the OECD's search strategy for ENVTECH, ICT and other technologies (Haščič and Migotto, 2015; Inaba and Squicciarini, 2017; Cárdenas Rodríguez at al., 2019).

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Inaba, T. and M. Squicciarini (2017), "ICT: A new taxonomy based on the international patent classification", *OECD Science, Technology and Industry Working Papers*, No. 2017/01, OECD Publishing, Paris, *https://doi.org/10.1787/ab16c396-en.*

Lax Martínez G., Raffo J. and k. Saito (2016), "Identifying the gender of PCT inventors", Economic Research Working Paper No. 33, World Intellectual Property Organization (WIPO), Geneva, *www.wipo.int/publications/en/details.jsp?id=4125.*

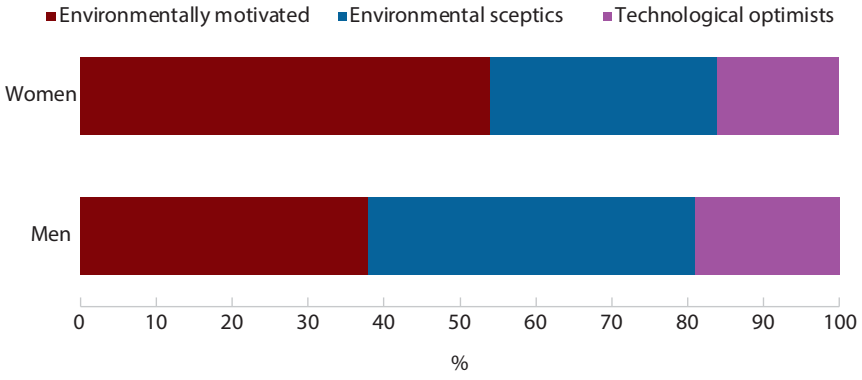
BOX 1. *Household surveys show gender differences in environment-related attitudes and behaviours*

Developing strategies that promote greener lifestyles requires a good understanding of what affects people's behaviour. The OECD has conducted large-scale periodic household surveys designed to shed light on household environmental behaviour and attitudes with regard to energy, food, transport, waste, and water and to examine how policies implemented by governments may affect household decisions. These surveys include gender and can help target policies in areas where men and women respond differently.

For example, the surveys reveal that attitudes about the environment vary by gender. When asked about the degree to which they agree with different statements on environmental policy, women's responses suggest they are more environmentally motivated (e.g. willing to make compromises that benefit the environment) than men, in all countries surveyed. Women are also less sceptical about the importance of environmental issues (Figure 6).

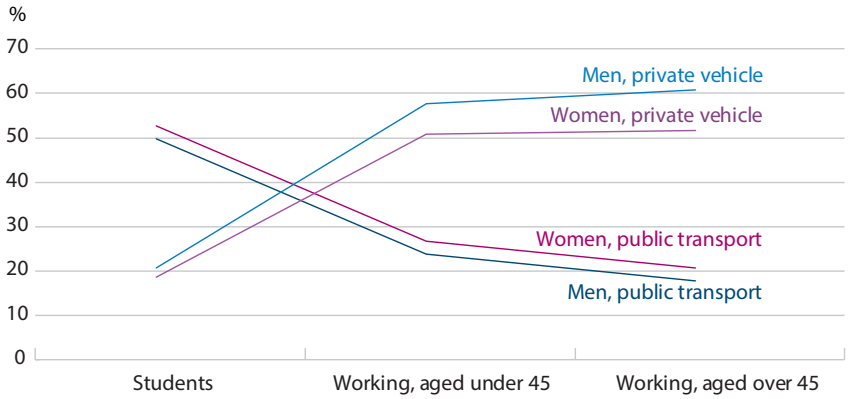
The surveys also reveal that transport choices are strongly associated with age and gender. Men are significantly more likely to commute by car than women: the difference between the use of private vehicles to commute to work by men aged over 45 compared to women in the same age group is 9% (Figure 7).

Figure 6. **Women are more likely to be environmentally motivated and less sceptical about environmental issues,** *environmental attitudes, 11 OECD countries, 2011*



Note: Based on surveys in eleven countries: Australia, Canada, Chile, France, Israel, Japan, Korea, the Netherlands, Spain, Sweden and Switzerland.
Source: OECD (2014), *Greening Household Behaviour: Overview from the 2011 Survey - Revised edition*, OECD Studies on Environmental Policy and Household Behaviour, OECD Publishing, Paris, *https://doi.org/10.1787/9789264214651-en.*

Figure 7. **Women are more likely to commute using public transport,** *Commuting by public transport and private vehicles, 11 OECD countries, 2011*



Note: Based on surveys in eleven countries: Australia, Canada, Chile, France, Israel, Japan, Korea, the Netherlands, Spain, Sweden and Switzerland.
Source: OECD (2014), *Greening Household Behaviour: Overview from the 2011 Survey - Revised edition*, OECD Studies on Environmental Policy and Household Behaviour, OECD Publishing, Paris, *https://doi.org/10.1787/9789264214651-en.*

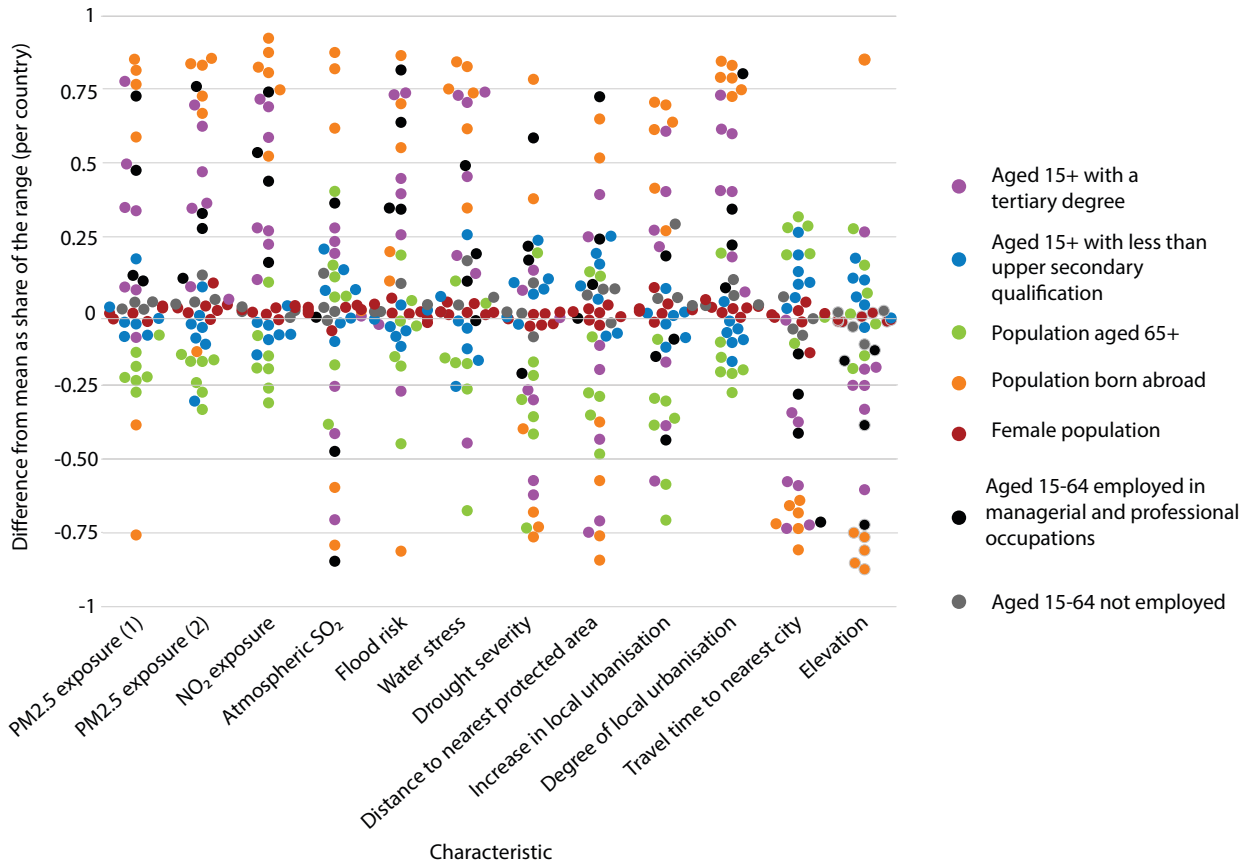
BOX 2. *Socio-demographic differences in exposure to air pollution: Insights from integrated geospatial data*

The OECD Geography of Well-being project links environmental data from Earth observation (including in-situ monitoring, remote sensing and modelling) with geo-referenced socio-economic data (e.g. small-area statistics from population censuses) to better understand the distribution of different population 'groups' and their local environmental quality. These groups include a breakdown by age and gender.

A preliminary analysis for seven countries (Argentina, Australia, the United Kingdom, France, New Zealand, South Africa and the United States) shows very small differences in local environmental quality observed between men and women across countries. This is perhaps to be expected because gender-based geographic sorting of residence is modest (i.e. in most places men and women tend to be more-or-less uniformly distributed across space). Differences are more likely to arise in terms of gender-differentiated health impacts (vulnerability) or via occupational exposure; however, measuring these differences remains a challenge due to a lack of suitable data, especially in the international context.

However, differences across other characteristics of the population can be observed. Older populations are considerably more rural and coastal and appear relatively less exposed to some air pollutants and river flooding. Older people also eschew higher-density areas with remarkable cross-country consistency and there is evidence that this ruralisation of the elderly is increasing in at least some countries (and conversely that younger people are becoming increasingly urban).

Figure 8. **There is little difference in local environmental quality observed between men and women**,
Relative exposure to environmental quality of different socio-demographic groups (approximately 2000-2010)



Note: Each dot in the figure represents one subpopulation (corresponding to colour) in one of the seven countries. When a subpopulation scores higher (which can roughly be considered 'worse' for most of the characteristics) than any other in that country, it means the average exposure of that subpopulation was high relative to the other subpopulations of that country.
Source: OECD Geography of Well-being project, initial results (November 2019).

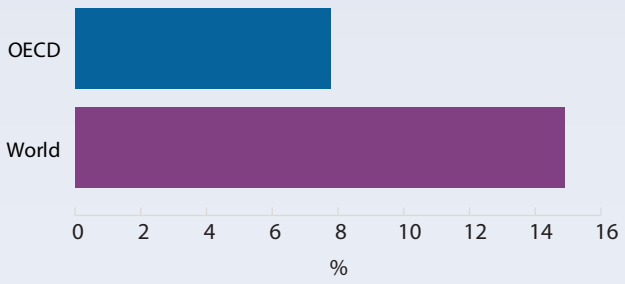
Gender differences in health outcomes from exposure to environment-related risks

A. Context

Environmental and occupational risks across all OECD members are estimated to be responsible for 8% of premature deaths (approximately 865 000 people) in 2017 compared to a global average of 15% (Figure 9). While high in absolute terms, across the OECD, behavioural risks like poor diet, tobacco use, alcohol consumption, and physical inactivity; and metabolic risks like high blood pressure, high blood glucose, high BMI, and high LDL cholesterol were greater contributors to mortality, respectively accounting for 37% and 34% of premature deaths.

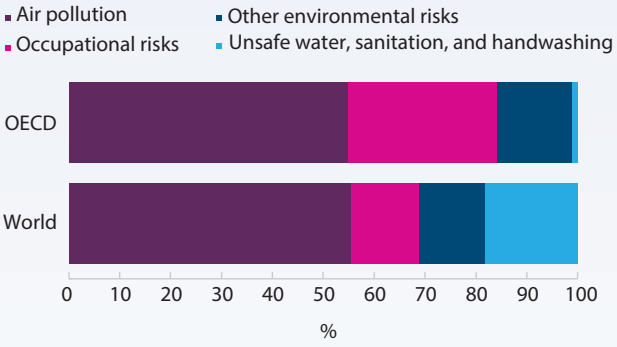
Poor air quality (primarily exposure to ambient fine particulates) was responsible for the majority of these 865 000 premature deaths in OECD countries. Occupational risks (mostly workplace exposure to carcinogens, particulates and injuries) came second; other environmental risks (lead & radon) third. The final category: deaths from unsafe water and sanitation, are uncommon in OECD countries but a significant contributor to global mortality (Figure 10).

Figure 9. **Environmental and occupation risks account for a smaller share of premature deaths in the OECD than the world average,** *share of premature deaths attributable to environmental and occupational risks (GBD classification), 2017*



Source: Institute for Health Metrics and Evaluation (IHME), GBD Compare.

Figure 10. **More than half of premature deaths attributed to environmental and occupational risks are caused by poor air quality,** *risk factors contributing to environmental and occupation-related premature deaths by share of deaths attributed (GBD classification)*



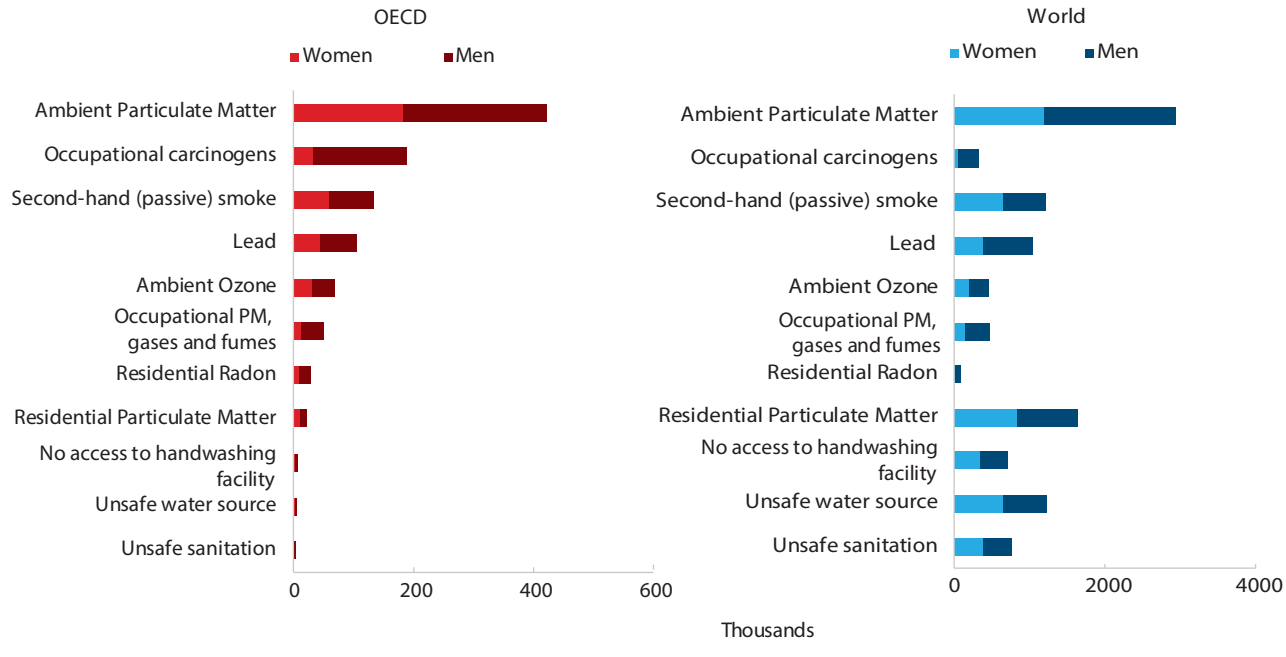
Source: Institute for Health Metrics and Evaluation (IHME), GBD Compare.

B. Main messages

Men and women are exposed to different levels of environmental and occupational risks and suffer different consequences. Available evidence suggests that these risks cause more male deaths in OECD countries, particularly exposure to ambient (outdoor) particulates and the environment-related occupational risks like exposure to occupational carcinogens and occupational particulates (Figure 11). Globally, more women are harmed by indoor air pollution, second-hand (passive) smoke, and risks relating to poor sanitation and water quality. This gap is typically wider in less-developed countries.

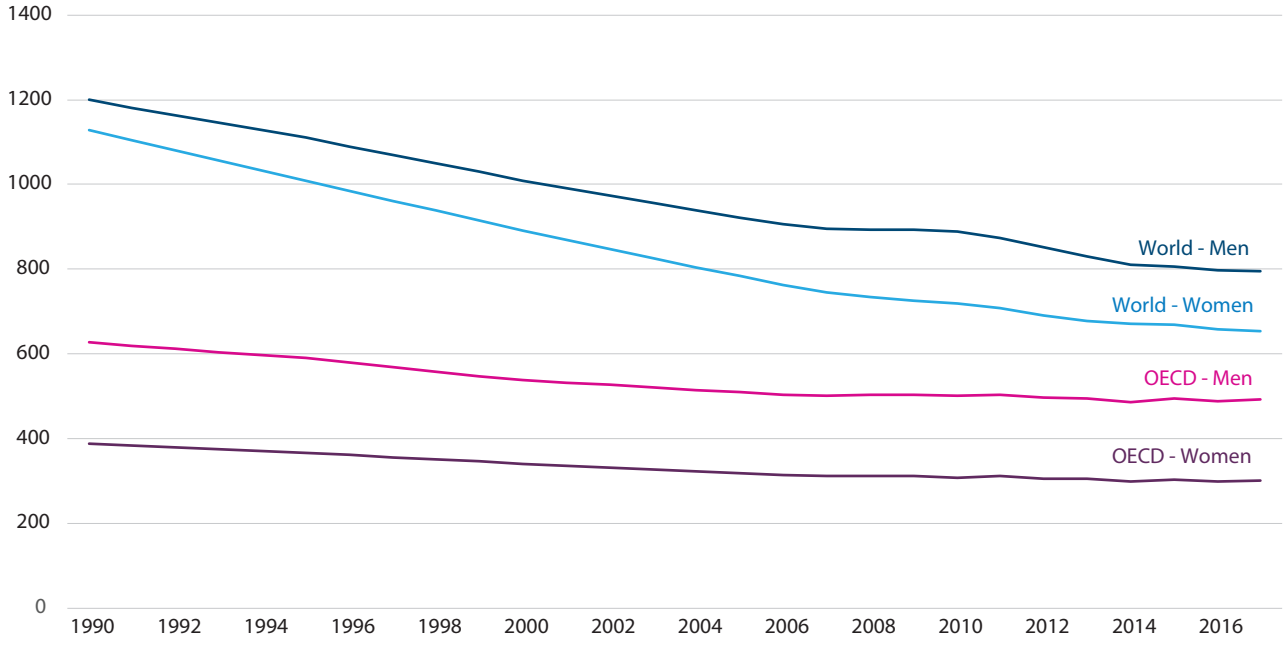
Overall mortalities from environmental and occupational risks have trended down (Figure 12). Improvement in ambient particulate matter was mainly responsible for the OECD decrease in environment-related premature deaths of around 18% since 1990. This decrease has included both men and women, across the OECD and the world. Some individual risks show an opposite trend: for example, deaths attributed to exposure to ambient ozone have increased over the same period.

Figure 11. **Men suffer higher mortality rates from ambient and occupational air pollution and occupational carcinogens, while women suffer more from residential particulate matter and unsafe water sources and sanitation,** *attributable premature deaths 2017, selected environment-related risks*



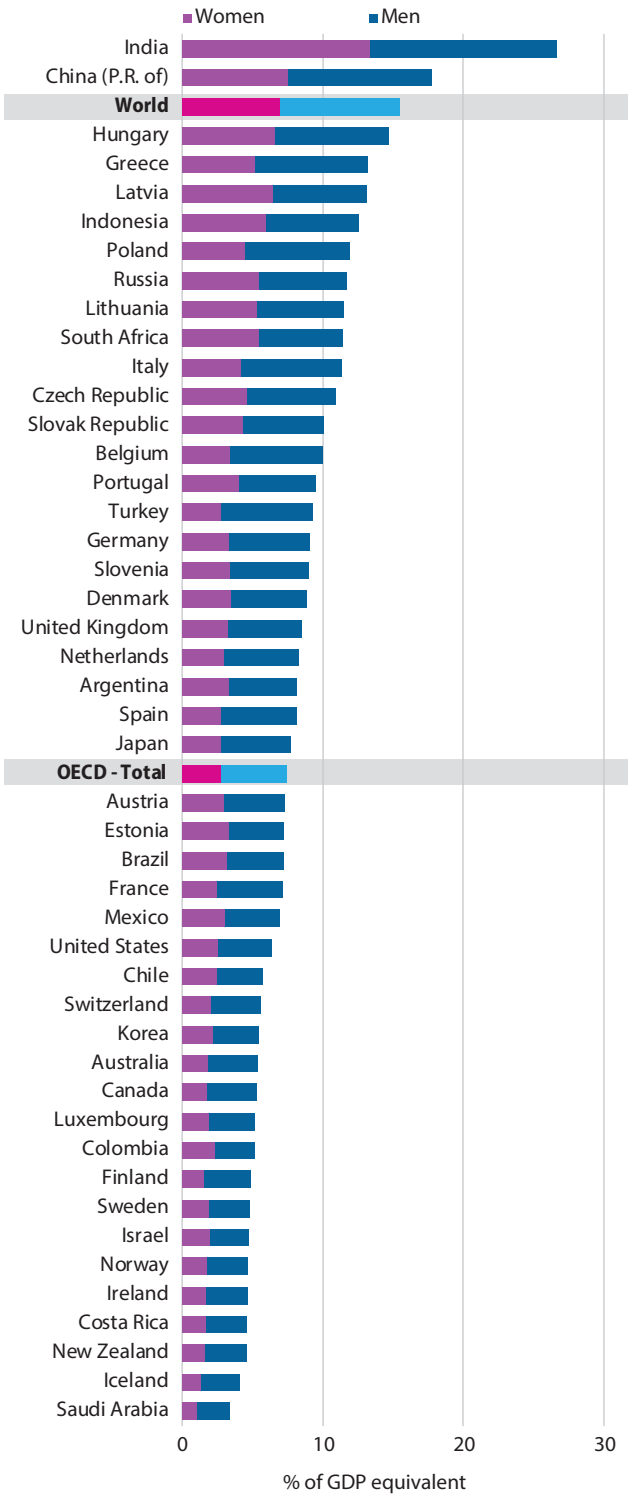
Source: OECD (2020), Air pollution effects (indicator) using data from IHME.

Figure 12. **Despite improvements in overall mortality numbers, a gender gap persists**, *mortality rate of selected environment-related risks (premature deaths per million inhabitants)*



Note: Includes the 11 risks included in Figure 11.
Source: OECD (2020), Air pollution effects (indicator) using data from IHME.

Figure 13. **The welfare cost of premature deaths attributable to selected environment-related risks often exceeds 5% of GDP,** *welfare cost of premature deaths, percentage of GDP equivalent*



Note: Differences between men and women are entirely explained by different mortalities. The VSL used for valuation is the same for men and women. Includes the 11 risks included in Figure 11.
Source: OECD (2020), Air pollution effects (indicator).

The welfare costs of these deaths are considerable. Using a willingness-to-pay methodology for valuing mortality shows the welfare costs for exposure to the list of environment-related risks for all OECD to be about USD 4 trillion for 2017, or 8% of GDP (Figure 13). This ranges from less than 5% of GDP for countries including Iceland and Ireland, to about 15% for Hungary (also the world average). Expressed per capita, this is equivalent to around 1 000 to 5 000 USD per capita per year among OECD countries.

C. Measurement

Mortality estimates are from the Global Burden of Disease project (GBD). GBD is a systematic, scientific effort to quantify the comparative magnitude of health loss due to diseases, injuries, and risk factors by age, sex, and geographic regions for specific points in time. Mortality estimates are a best-estimate relying on virtually all data available to the global epidemiological community; however, they sometimes have high levels of uncertainty and there are missing risk factors to which the available evidence does not permit the attribution of mortality and morbidity. Welfare costs are calculated by OECD using the Value of a Statistical Life method.

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Next steps

More comprehensive understanding of the potential gender differences in environment-related domains requires a dedicated effort directed at collecting gender-disaggregated environmental data (e.g. individual-level data on exposure to air pollution, noise, and other environmental risks).

In addition, the gender dimension could also be explicitly identified in existing databases (e.g. cadastral, taxation and other public administration records; data from meters or surveys on consumption of energy, water and fuels as well as on waste generation and recycling patterns; firm- and industry-level data on women's participation in senior management and their roles in production of environment-related goods and services, fossil fuels industry and natural resource management). Integration of existing databases (e.g. linking using common identifiers) is another alternative.

Better understanding of differences between men and women in their preferences and attitudes towards the environment, their aversion to environment-related risks, and their acceptance of environmental policy instruments (e.g. carbon tax), etc could help better target environmental policies and improve environmental outcomes more effectively.

For more information:

www.oecd.org/environment/gender-inclusiveness-and-sdg.htm

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Researchers or institutions interested in developing new evidence on gender and environment issues are invited to contact the team:

Nathalie Girouard
Head of Division
Environmental Performance and Information
nathalie.girouard@oecd.org

Ivan Haščič
Senior Economist
ivan.hascic@oecd.org

Sigita Strumskyte
Co-ordinator for Gender and SDGs
sigita.strumskyte@oecd.org

Miguel Cárdenas Rodríguez
Statistician
miguel.cardenasrodriguez@oecd.org

Alexander Mackie
GIS Analyst
alexander.mackie@oecd.org

Natasha Cline-Thomas
Communications Co-ordinator
natasha.cline-thomas@oecd.org

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