



Energy Transition

Green tech talent required to
boost net zero

Executive Summary

Technologies and talent: energy transition brings structural changes

The energy industry is changing rapidly, and so is its workforce.

It is only natural that during this period of change it can be difficult to understand where the energy transition is taking us and what talent profile is needed to lead this transformation.



Building a tomorrow ready workforce

Our intention is, therefore, to understand the following two factors:

- **How can the technology sector support the energy industry?**
- **What are the talent and skills requirements to meet the energy transition?**

The energy transition is underway, and there is no sign of a slowdown. However, the lack of experienced professionals and high demand for tech talent in the industry has been a big concern among leaders worldwide.

54%

of energy providers say they have a talent gap in AI, architecture and data science skills.

This whitepaper investigates how the technology sector can support the energy industry and build a future proof workforce to ensure we will succeed globally in our net zero goals.

- What are the talent and skills required to meet the energy transition?
- What are the top courses and the transferable skills between the industries?
- Where do we see demand for talent, and what does the future bring?

A hand is shown holding a glowing green circular interface. The interface features a central circular icon with a leaf design. Surrounding this central icon are several smaller circular icons connected by dashed lines, representing various sustainability themes: a factory with smoke, a CO2 molecule with downward arrows, a wind turbine, a recycling symbol, a battery, a plant, and a globe with a recycling symbol. The background is a blurred green, suggesting a natural environment.

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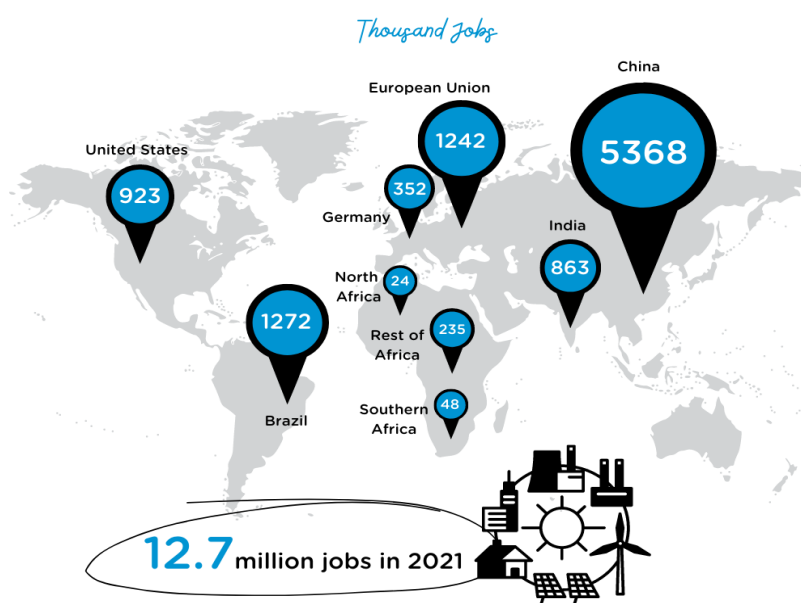
1.0 The energy transition and the high demand for talent

Collectively, we know the energy transition goes well beyond technology and brings deep structural changes that will significantly impact economies and societies.

The number of jobs in the energy sector could rise to **139 million jobs in 2030**, including 38.2 million workers in the renewable energy industry under the 1.5°C scenario, where we will be able to limit global warming at 1.5 degrees Celsius above pre-industrial levels. By doing this, we can avoid some of the worst impacts of climate change.

This whitepaper investigates the sectors, technologies, and the type of workforce required to cut greenhouse gas emissions close to zero (net zero).

Figure 1: Renewable energy employment by region.



Source: IRENA Jobs Database /
Renewable Energy and Jobs: Annual Review 2022

According to [Accenture's 2022 New Energy Consumer global survey](#), energy providers reported that finding the right talent to drive digital innovation is their second biggest barrier to improving customer experience.

54 per cent say they have a talent gap in AI (Artificial Intelligence) architecture and data science skills.

Furthermore, the pandemic era shift to remote working has also brought about changes in the relationship between companies and employees.

In our latest [GETI report](#), “changing ways of working” was listed as the third most significant challenge in the renewables sector over the next three years.

A new workforce has already begun to emerge, and it is significantly more adaptable to current times.

1.1 Renewables will create millions of job opportunities

Going green is no longer a choice due to urgent climate needs, political commitments, and market trends. The energy transition is a journey, and it is underway. As a result, there is now a need for more talent in this space than ever before.

Companies worldwide are dedicated to developing technologies, policies, and strategies to meet their global and local net zero targets. As a result, there is now a need for more talent in this space than ever before.

The energy transition will bring deep structural changes that will significantly impact economies and societies.

In 2021, the number of people directly or indirectly employed in renewable energy was [12.7 million](#), according to the Annual Review 2022 report by the International Renewable Energy Agency (IRENA) and International Labour Organization (ILO).

The industry has also made advances in workforce gender equity, with women accounting for one-third of them.

Looking to the future, we anticipate a high demand for talent in the cleantech energy industry. As a reminder, a transformed energy sector could have 139 million jobs in 2030.

The [workforce](#) plays a central role in meeting the continued acceleration of clean energy generation expected in upcoming years.

1.2 The tech transformation in the renewables sector

One of the critical public challenges to meeting net zero carbon emissions by 2050 has been around innovation and technology.

The power that digital transformation holds within the energy transition is a consensus amongst experts in the industry.

“Digital transformation programmes and specifically the move to a more automated technical workspace dominate the landscape in renewable tech.”



Toby Brown
Director at Airswift

The statement above highlights how the renewables industry will evolve and is directly linked to its ability to transform digitally.

Tech is now everywhere, changing the way we produce, work, and consume electricity.

Renewable energy sources, such as wind and solar, are set to account for nearly 70 per cent of global electricity production in 2050, and 50 per cent of all new cars sold globally are predicted to be electric by 2033. The energy industry is shifting rapidly due to technological advances and **datafication**.

But the industry still faces tech challenges when it comes to utilising all the benefits of the renewables sector, such as predictability and storage.

According to the **United Nations**, at least \$4 trillion a year needs to be invested in renewable energy until 2030 – including investments in technology and infrastructure.

Because of this, a career in renewable energy would be an excellent fit for tech professionals on the lookout for roles in a challenging and innovative industry that is intent on making positive change.

1.3 The energy career is more than ever a tech one

There is still a large gap between the supply of qualified tech professionals and the growing need for them. And that's due to the fact that technology careers are becoming cross disciplinary.

The modern **energy career** involves technical roles such as software engineers, data scientists, cloud specialists and more.

The good news for these professionals is that they can be a key resource to decarbonising and safeguarding the planet for future generations while working in the energy market, one of the highest paying industries in the world. The **2022 Global Energy Talent Index (GETI)** report found that the talent gap has sent salaries soaring, with 40 per cent receiving a pay rise in the renewables sector.

2.0 How many clean energy jobs are in demand?

In 2030, the renewable energy industry is expected to employ roughly 38.2 million workers worldwide under the 1.5°C Scenario. Before giving light to other numbers, it is essential to clarify a few points.

The **1.5°C Scenario** is an ambitious energy transition scenario with front loaded investments needed to achieve the 1.5°C Paris climate goal.

The number of jobs in the energy sector could rise to 139 million, including more than 74 million in energy efficiency, electric vehicles, power systems/flexibility and hydrogen.

Under a **Planned Energy Scenario** (PES) – based on current policies and plans – the global economy creates fewer jobs than the 1.5°C Scenario.

- 106 million energy jobs
- 17.4 million renewable energy jobs
- 45.8 million energy efficiency, electric vehicles, power systems/flexibility and hydrogen jobs

Key facts:

- Currently, around 12.7 million people are employed within the renewable energy sector.
- Solar photovoltaics is responsible for a third of jobs.
- Close to two-thirds of all renewable energy jobs are based in Asia.
- China led 42 per cent of the global total renewables jobs last year, followed by the EU and Brazil with 10 per cent each, and the USA and India with 7 per cent each.
- The high talent demand can be seen in the main segments of the value chain, including manufacturing equipment, construction and installation, and O&M.

“Solar installers and wind technicians have been the fastest growing jobs in the US for years, and Airswift is seeing increasing demand for talent across the entire life cycle, from office workers, technology and factories to construction and operations & management roles. Competition is the biggest challenge.

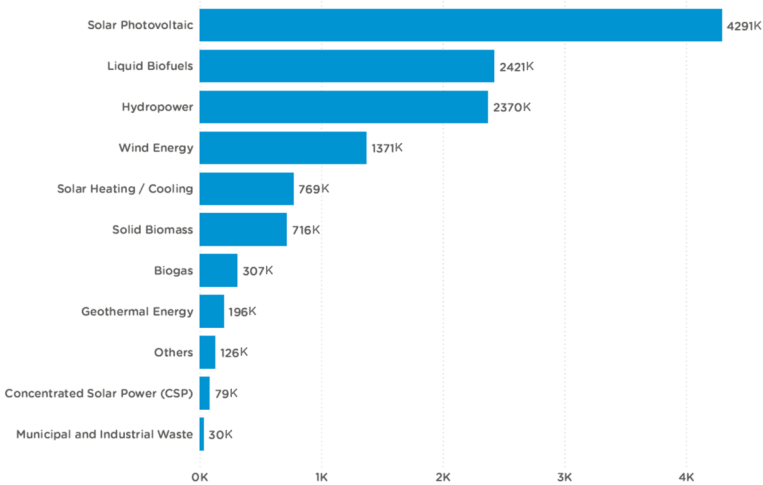
The need for top talent in the energy and renewables space has grown exponentially in the last few years and shows no signs of slowing down over the next decade.

However, increased needs come with their own set of challenges, such as roles staying open longer, resulting in lost time; underqualified candidates engaging job boards and not finding the “perfect fit”; counter offers and competitors closing in on selected talent; and family taking precedence over work (e.g., benefits packages, remote work, flexible schedules).”



Ashley Samuelson
Director at Airswift

Figure 2: Global renewable energy employment by technology (2021).
Thousand Jobs



Source: IRENA Jobs Database /
Renewable Energy and Jobs: Annual Review 2022



2.1 What are green skills and green jobs?

We are at an unprecedented moment when leaders worldwide are rethinking business models and reimagining the future of work.

New policies and programmes have been created to [attract and retain](#) the employees that will be needed to empower the green economy.

But what are the [green skills](#) and green jobs required for the energy transition?

First, let's take a quick look at the terminology. In short, green skills are the knowledge, abilities, values, and attitudes that enable the environmental sustainability and resource efficiency of economic activities.

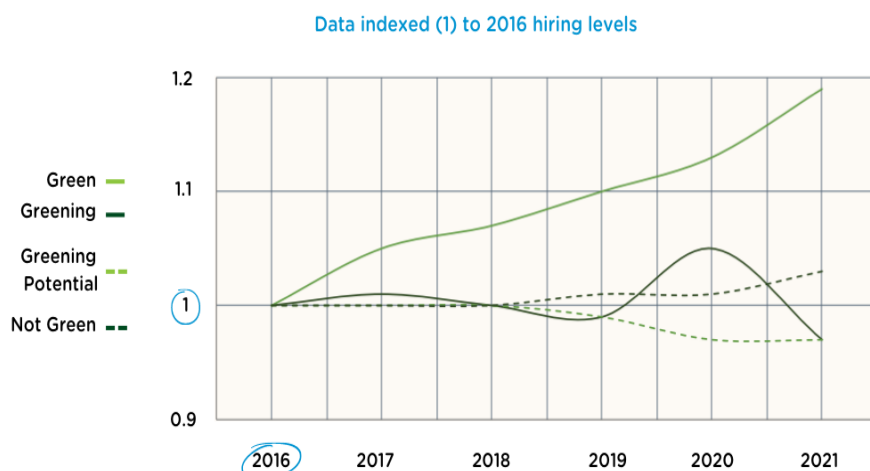
Green jobs are those that cannot be performed without knowledge of green skills.

At LinkedIn, which has nearly 800 million members worldwide, the share of green talent increased from 9.6 per cent in 2015 to 13.3 per cent in 2021 – a growth rate of 38.5 per cent.

The biggest challenge for the market is to equip workers with the future skills required to meet this growing demand. While job postings requiring green skills grew 8 per cent annually over the past five years, the share of green talent has only grown roughly 6 per cent annually in the same period on the platform.

According to the [Global Green Skills Report 2022](#), the renewables and environment sector will outnumber oil and gas in total jobs on the LinkedIn platform by 2023. The future of work is green, and the time to create a tomorrow ready workforce is now.

Figure 3: Change in the share of global hiring by job type.



Source: Global Green Skills Report (LinkedIn, 2022)



Looking again at LinkedIn’s Global Green Skills Report, we can see the top in demand green skills requested by employers in 2021.

Figure 4: Top in demand green skills requested by employers in 2021.

Top in-demand green skills required by employers (2021)

Skill Name	Green Skill Category	Share of job postings requiring the skill
Sustainability	Sustainable Development	27.6%
Remediation	Environmental Remediation	8.8%
Occupational Safety and Health Advisor (OSHA)	Environmental Policy	8.6%
Climate	Ecosystem Management	5.6%
Renewable Energy	Renewable Energy Generation	5.4%
Environmental Awareness	Ecosystem Management	4.9%
Environment, Health and Safety (EHS)	Environmental Auditing	3.7%
Solar Energy	Renewable Energy Generation	2.6%
Corporate Social Responsibility	Environmental Policy	2.5%
Recycling	Environmental Remediation	2.1%

Source: LinkedIn’s Global Green Skills Report 2022



Over
90%
of oil and gas professionals have medium to high skills transferability.

2.2 Transferable skills between the energy industries

Fossil fuels have dominated the 20th century, but there is no doubt that cleantech will power the 21st century.

Although there are robust predictions for employment in clean energy, there is still a lack of experienced field technicians, engineers, and tech skills professionals.

The good news is that a study conducted by Robert Gordon University (RGU) in 2021 revealed that over **90 per cent of oil and gas** professionals have medium to high skills transferability.

These professionals are vital talent resources to the renewable energy industry and are in a strong position to work within offshore wind, hydrogen fuel, and carbon capture technology.

If you’re a jobseeking professional, find out the skills in demand, knowledge, and experience that make you a suitable candidate for a transition from **oil and gas to green energy**, especially in project management, engineering, construction, finance, and operations.

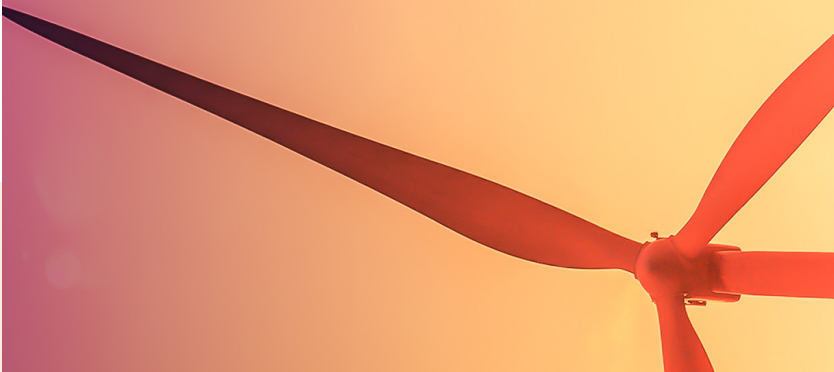
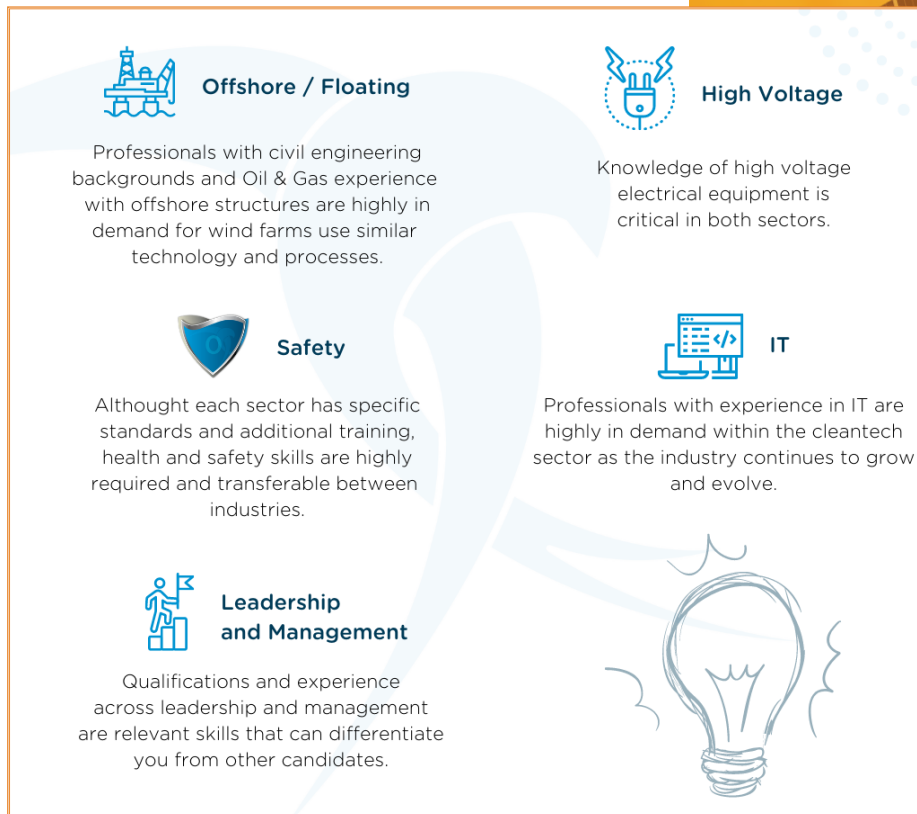


Figure 5: Top five transferable skills from traditional to clean energy.



“As with many industries across the world, most companies within the Renewables Industry are experiencing skills shortages. These shortages result in a massive dependence on the successful retention of talent. This includes candidates working on both a permanent and contract basis.

Disciplines across the Renewables industry are often related to new technology, and therefore finding talent with experience specific to this technology can be difficult. Often, companies will rely on identifying candidates with transferable skills.”



Jordan Mason

Contract Recruitment Manager at Airswift

2.3 Which skills should the tech workforce have?

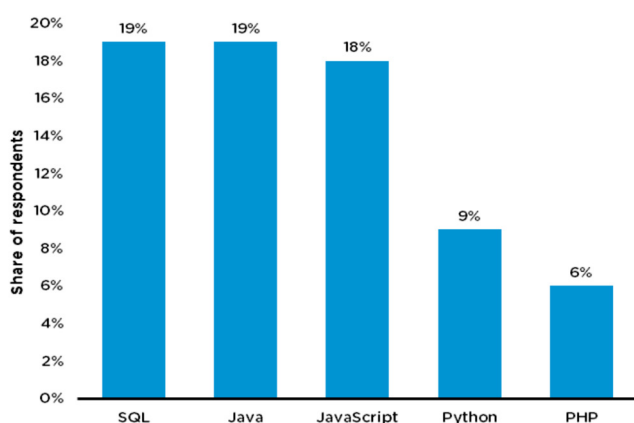
Recruiters are searching for workers with strong math and data analysis backgrounds that can manage themselves and collaborate with a diverse team.

To spark the next wave of digital transformation, energy must compete with other sectors, including information and communications technology (ICT) and healthcare, just to name two niches that will be competing for top tech talent.

The ongoing digital transformation in energy is causing changes in recruitment expectations. As mentioned above, tech talent are now looking at the energy industry with different eyes.

Further analysis shows us which programming languages are the most in demand by different industries on a global scale.

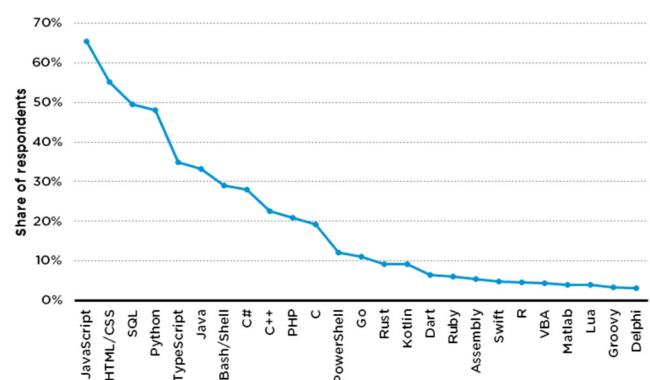
Figure 6: Most in demand tech skills worldwide in 2022.



Note(s): Worldwide; December 1, 2020 to December 1, 2021; There were 102,869 coding tests submitted by developers in 191 countries and 700 customers of DevSkiller in 90 countries.
Source(s): DevSkiller; [ID 1292294](#)



Figure 7: Most used programming languages globally.



Note(s): Worldwide; May 11 to June 1, 2022; 71,547 respondents; Software developers.
Source(s): Stack Overflow; [ID 793628](#)



Will Bernholz, 8 Rivers' VP Marketing, highlights the importance of having people from different backgrounds in this crucial moment of scaling potential net zero technologies:

“We really prioritise and welcome a multidisciplinary team. We need professionals with experience within oil, gas and energy, but we also benefit greatly from the expertise of those with skills and experiences outside of those sectors.

I’m an example of someone who comes from the software industry. We have people coming from banking and finance and that interdisciplinary approach is actually what makes us unique and applies to our people and to our technologies.”



Will Bernholz
VP Marketing at 8 Rivers

We are talking about an ecosystem that needs to receive infrastructure investments so that companies can scale their technology stacks. There are currently various efforts from companies providing solutions to other companies trying to navigate the energy transition.

One good example of such company is [8 Rivers](#), which is the only climate technology company today delivering diversified net zero solutions to meet the world’s most challenging clean energy needs.

New climate tech companies are materialising every day, bringing with them new tech workforce armed with unique sets of skills and experiences. As this continues, we can expect to see a crossover skills as the energy sector goes through its digitisation era.

3.0 What are the educational programs for training these new workers?

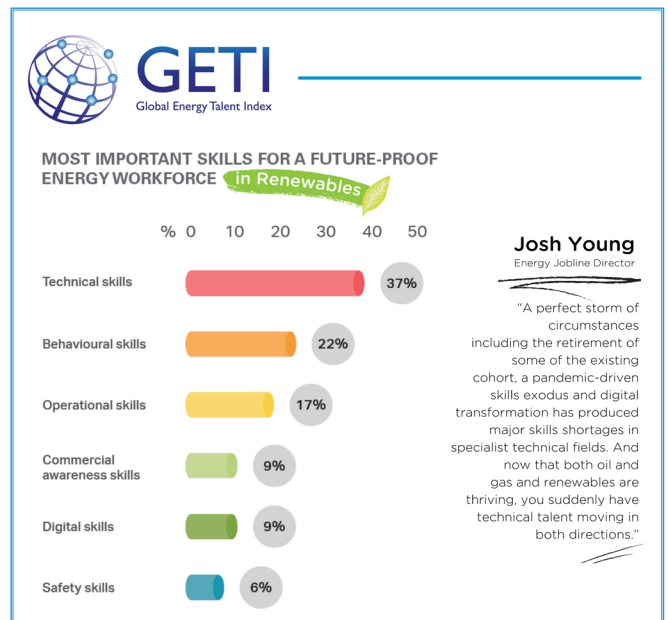
The workforce of the present and the future needs to arm itself with a combination of in depth technical knowledge and a wide range of soft skills. What we've recently observed in law sciences is a good example of this convergence of skill sets.

Many professionals in this area are known as “T-shaped lawyers”; highly skilled individuals with very deep expertise in a core discipline but are also well versed in a range of other competencies. This allows them to effectively collaborate with those from other disciplines and adapt to new and changing environments.

This is, in some ways, the path energy professionals are walking to meet the industry's demands. In the **2022 GETI report**, experts were interviewed to explain how hard and soft skills will stand together in the hall of desired skills during the energy transition.

Both hard and soft skills will allow professionals to act and think critically in the face of the environmental challenges that lie ahead. These characteristics, combined with an affinity towards achieving sustainability goals, create a unique candidate profile within the market.

Because of this, schools have been creating courses to develop the ideal professional capable of keeping the energy transition in progress whilst also leading the charge towards its continued evolution.



Eduardo Halpern, former Dean of Undergraduate Programs at Ibmecc, and current Academic Dean at Celso Lisboa in Rio de Janeiro (Brazil), said:

“Today, more and more, we are seeing that the professional is not a person who only deals with technology in the simplest sense of the word; they also have to manage teams, deal with customers and establish relationships with stakeholders.”



Eduardo Halpern
Academic Dean at Celso Lisboa

Halpern leads the coordination of technology courses at Celso Lisboa, where he, through an active methodology, combines the development of hard, soft, and green skills in the tech student.

“In the last two years, the Covid crisis led to a huge increase in demand for professionals in the health sector. Society as a whole and the job market consequently woke up to the need for this workforce. The same thing has been happening from another perspective with the energy market. Today the search for efficient, cheap, and sustainable energy sources is a major concern of governments, industries, and professionals who can manage renewables and think of more sustainable and economical ways to make the most of these sources.”



Eduardo Halpern
Academic Dean at Celso Lisboa

3.1 Courses available

Many schools offer courses to train generations of workers that specialise in creating and dealing with environmental friendly solutions.



MIT Energy Initiative

One of the endeavours worth mentioning is the [MIT Energy Initiative](#), an education and research hub of the Massachusetts Institute of Technology. It was created with a mission to develop low and no carbon solutions, thus contributing to the fight against the climate crisis.

The hub supports undergraduate, graduate, and postdoctoral scholars with studies in strategic areas in the renewable energy industry.



The Robert Gordon University in Scotland has also joined the front in impacting the energy industry with a new generation of talent. Its School of Computing offers "[IT for the Energy Industry](#)", a postgraduate program that connects software development with the renewable energy scenario.

The university is recognised for its emphasis on energy subjects and has been carrying this tradition for more than 50 years. Its School of Engineering introduced the first energy course in 1971.



The [Cleantech Institute](#) is located at NASA's Ames Park in San Jose, California and operates as a research, consulting, and training organisation for the renewable energy industry.

It is responsible for training and is important for providing certifications for vital jobs relating to emerging clean technologies in the energy industry. Some of the training programs include:

- Certified Electric Vehicle Technician (CEVT) training program
- Certified Photovoltaic Systems Specialist (CPVS)
- Certified Nanotech & Cleantech Professional (CNCP)

Other courses and institutes

Several programs worldwide have been involved in training the workforce to help us reach net zero by 2050. Here are more **courses** that hold a place for the next set of energy innovators:

- [Bachelor in Engineering of Mining and Energy Resources](#) (University of Oviedo, Spain)
- [Bachelor in Environmental Science for Sustainable Energy and Technology](#) (Avans University of Applied Sciences, Netherlands)
- [Bachelor of Science in Energy Technologies](#) (Gdańsk University of Technology, Poland)
- [Bachelor's Programme in Energy Technology](#) (LUT University, Finland)
- [Master's Programme in Sustainable Energy Engineering](#) (KTH: Royal Institute of Technology, Sweden)
- [Master's Programme in Sustainable Energy Futures](#) (Imperial College, England)

Other **institutes** teaching the new generation of green tech talent and researching the future trends of sustainable development include:

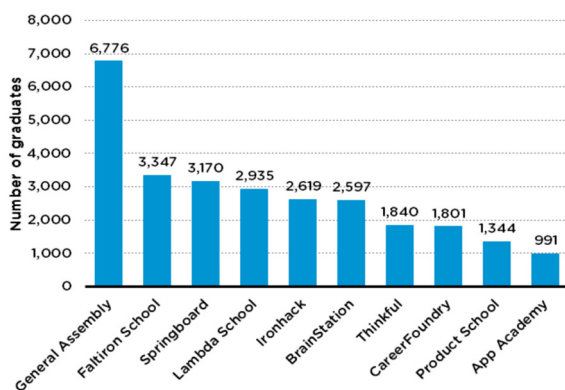
- [School of Sustainability](#) (Stanford University, United States)
- [Institute of Nuclear and New Energy Technology](#) (Tsinghua University, China)
- [Faculty of Bioscience Engineering](#) (KU Leuven University, Belgium)
- [Department of Engineering of Science](#) (Oxford University, England)
- [Centre for Energy Research](#) (Indian Institute of Science, India)
- [Tecnológico de Monterrey](#) (Monterrey University, Mexico)
- [The Engineering School](#) (University of São Paulo, Brazil)

3.2 Bootcamps offer an approach for upskilling

There is consensus among many college CEOs that bootcamps are a key factor in the drop in higher education enrolment. It is no surprise that many universities are now partnering with bootcamps to create new course offerings.

These learning accelerators can be a cost effective solution for technology students. Bootcamps are usually 10-15 week programs that aim, through practice, to fill the gap in programming skills required by the market and provide networking opportunities with industry professionals.

Figure 8: Number of graduating students from coding bootcamps in the USA (2020)



Note(s): United States; January 15 through January 29, 2021; 44,254; coding bootcamp graduates on LinkedIn, bootcamp websites, and Career Karma's internal directory of schools. Further information regarding this statistic can be found on [page 8](#).
Source(s): Career Karma: [ID:1195283](#)



It is imperative that companies hire people with contacts outside their industry. These people may be able to help companies gain access to new markets and opportunities. And they might even be able to develop better communication skills and other soft skills.

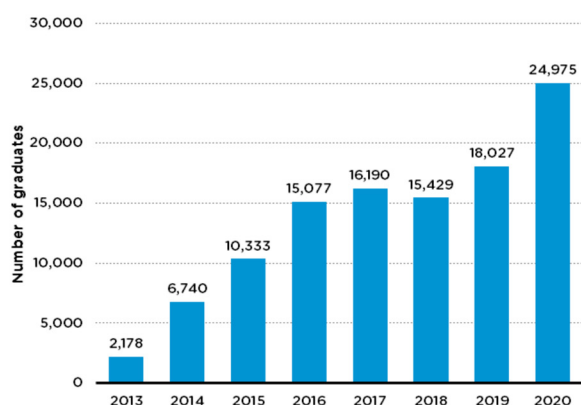
Today, there are even specific bootcamps for technology professionals who will be part of the energy industry. Some examples are the **Green Tech Festival** and the **Web Builders Bootcamp**.

Colleges do not want to be left behind in this race to develop technological talent. That's why many have partnered with bootcamps to create their own learning accelerator programs. This is the case for the following:

- Flatiron School and its partnership with the University of Cambridge
- California Institute of Technology's Center for Technology and Management Education launched its cybersecurity bootcamp with an outside partner
- University of California (Irvine) joined forces with Trilogy Education Services to develop programs around data analytics and cybersecurity training

The tech talent shortage faced by the renewable energy industry is a major pitfall amidst a journey towards reaching net zero emissions. Bootcamps offer a route to quickly develop and deploy a tech workforce as energy targets continue to swell.

Figure 9: Number of graduating students from coding bootcamps in North America 2013-2020.



Note(s): Canada, United States; 2013 to 2020; 97 respondents; coding bootcamps/accelerated learning programs
Further information regarding this statistic can be found on [page 8](#).
Source(s): Course Report; ID: 626932



The increasing demand for these accelerator programs demonstrates the need for technology skill development. It becomes even more urgent when we consider the need for skill development specific to green technology.

Not only is the potential for emergent technologies behind this need, but also new policies pushing companies to adopt a greener future.

That can be seen in companies developing environmental, social, and governance (ESG) strategies. The ESG policies are designed to ensure that companies operate sustainably.

This includes ensuring that employees are trained on how to protect the environment, as well as how to work effectively within communities.

ESG has become an important part of corporate governance for companies who want to protect their reputation and brand value, and more effectively do their part in helping the environment.

So, it makes sense that companies would invest in hiring talent developed within a green philosophy and have experience working with sustainability. Companies are looking for graduates who understand the importance of sustainable practices and understand how to apply those principles in their daily lives.

That's why there is so much interest in green technology education programs. Companies want graduates who understand the importance and application of sustainability.

They need graduates who can be immersed in this reality and help companies implement these principles into their daily routine. And, again, bootcamps are one way to achieve this engagement and development.

4.0 There is no lack of good reason to invest in ESG

Today it is essential to measure the results of environmental, social and governance (ESG) policies. Companies increasingly understand the importance that a sustainable agenda has.

We constantly see businesses being held accountable for transparency and efficiency in reducing their environmental impact. As this is in the DNA of climate tech companies, its workers come out ahead as experts in understanding what works and what doesn't.

From this, Eduardo Halpern concludes:

4.1 Consumer behaviour and market maturation

The maturing of the renewables market is an important point to highlight in the current tech scenario.

Many technologies that were once elusive are now presenting themselves as an integral part of our reality.

And, of course, changing consumer behaviour plays an important role in this.

Electric cars for example, are no longer an exclusive commodity, and several companies have emerged presenting solutions in the entire context of sustainable mobility.

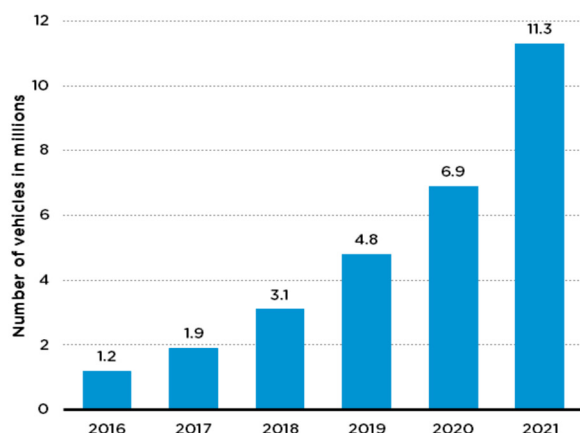
“In a world where companies are increasingly concerned with implementing an Environmental, Social and Corporate Governance (ESG) policy, you see a growing demand for professionals from different areas who know how to handle their projects sustainably.”



Eduardo Halpern

Academic Dean at Celso Lisbo

Figure 10: Worldwide number of battery electric vehicles in use from 2016 to 2021 (in millions).



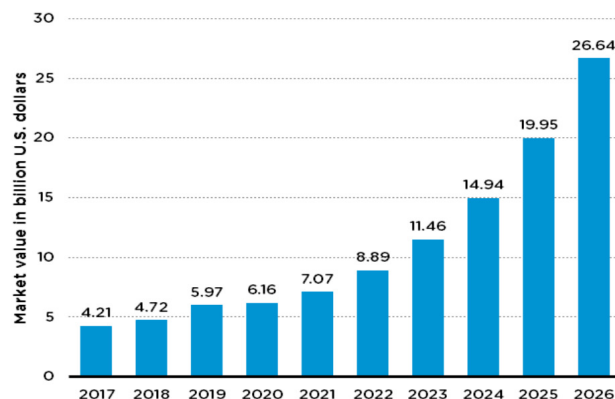
Note(s): Worldwide; 2016 to 2021

Further information regarding this statistic can be found on [page 8](#).

Source(s): IEA; ID 270603



Figure 11: Electric vehicle private charger market value worldwide 2017-2021, with a forecast through 2026 (in billion U.S. dollars).



Note(s): Worldwide; 2017 to 2021

Further information regarding this statistic can be found on [page 8](#).

Source(s): Daedal Research; ID 1314165

It's no wonder that as of 2017, the value of the electric private charger market has grown by more than 600 per cent worldwide.

With ESG increasingly important for investors, companies are investing more in data collection and auditors.

It shouldn't be surprising that a [study](#) by Northern Trust and PricewaterhouseCoopers (PWC) revealed that 89 per cent of asset managers and 79 per cent of asset owners across Europe,

Middle East, and Africa (EMEA) and North America identify "collecting and analysing data" as a top challenge in integrating ESG into their investment processes.

People around the world are becoming increasingly concerned about the environment, and they want organisations to act against climate change.

These concerns are reflected by workers citing environmental, social and governance (ESG) aspects when deciding whether to stay at their current employer or move

ESG policies can help companies plan initiatives such as **sustainable development**, **ethical green businesses**, and **carbon reduction**. And they are coming into play to support talent retention.

elsewhere, according to the [GETI report](#).

The survey also shows that employees' decisions to relocate are heavily affected by lifestyle and family considerations. This evidence suggests a belief led workplace where employees value ethical business decisions and work/life balance over monetary compensation.

The same study also shows that most workers don't even consider their salaries as a top priority when making decisions regarding which job they want to take.

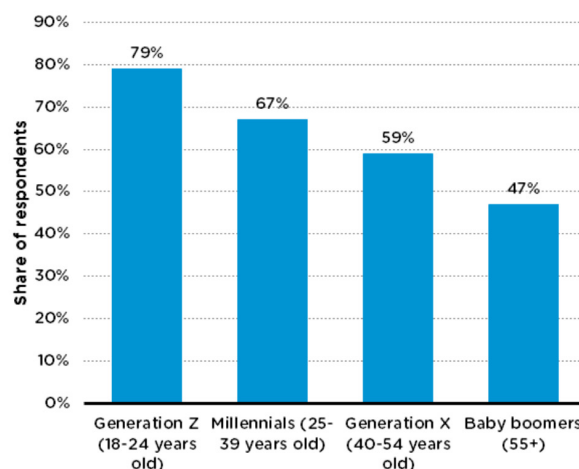
More than half of employees surveyed said that they wouldn't work for an employer they believed was unethical, no matter the pay.

This data highlights why it is so important to have a clear strategy in place for your organisation's sustainability efforts.

Carbon footprint consciousness could be a game changer for the future of your business as our chart shows.

It's not just about reducing emissions or being eco friendly. It's about creating a culture where people feel valued and appreciated since our lives are directly affected by the environmental's health.

Figure 12: Carbon footprint consciousness among consumers in 2021, by generation.



Note(s): Worldwide; 2021; 18 years and older; 2500 respondents; consumers in U.S., UK, Canada, France, and Spain. Further information regarding this statistic can be found on [page 8](#). Source(s): Oracle; Untold; [ID 1239441](#)



4.2 The government's role in the development of a green tech job market

In the global race toward net zero carbon emissions, governments play an essential part in supporting the development of a cleantech job market. They can choose from a wide range of policy interventions and financing measures to support this transformation.

Some countries offer subsidies and grant funding to research institutes, academic institutions, and private R&D firms to boost innovation and training. Other regions are building programmes, workforce roadmaps, and policies highlighting good practices and strategies for the short and long term.

5.0 What market will match this new workforce?

In today's market, we see how countries have taken advantage of their strengths to turn energy transition challenges into opportunities.

In the macroeconomic scenario, it is normal to identify three variables that can define the performance of these domestic markets. Countries may have one of the following conditions concerning the development of their industry:

- **Commodity dependence.** Some countries are more dependent than others on basic commodities.
- **Technology dependence.** Innovative technology solutions can be reflected in the number of patents filed.
- **Trade dependence.** Certain markets will have the ability to be exporters or importers of certain manufactured products. However, this ends up generating a discussion about decisions involving the reduction of taxes or investment in local industry.

So, it is within this scenario that we see different markets around the world developing in green tech clusters. This has given room for a variety of diverse companies to come up with exciting solutions for the future of renewable energy.

With a remarkable evolution in clean technologies, it is exciting to see companies present disruptive products and services aimed at solving our climate problem.

But what are these emerging technologies that have been drawing the attention of investors and consumers?

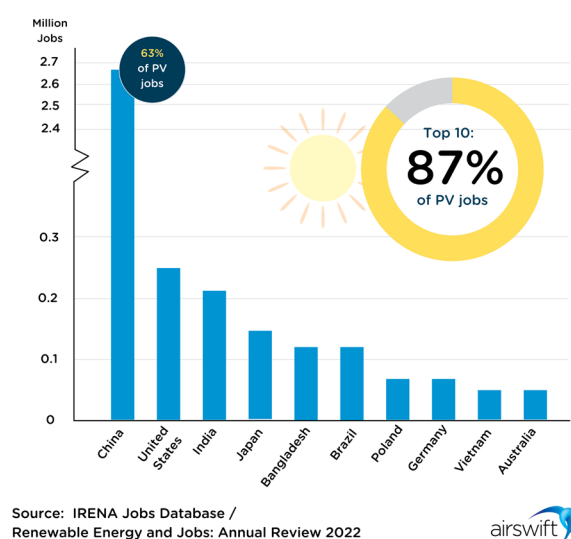
5.1 Where do we see a demand for talent?

According to the new International Energy Agency (IEA) report, global employment in the energy sector has risen above its pre-pandemic levels, led by increased hiring for clean energy.

Renewables surpassed the [50 per cent mark](#) for its share of total energy employment for the first time.

In this chapter, we will discuss some of the green technologies that are leading the way.

Figure 13: Solar employment in 2021: Top ten countries.



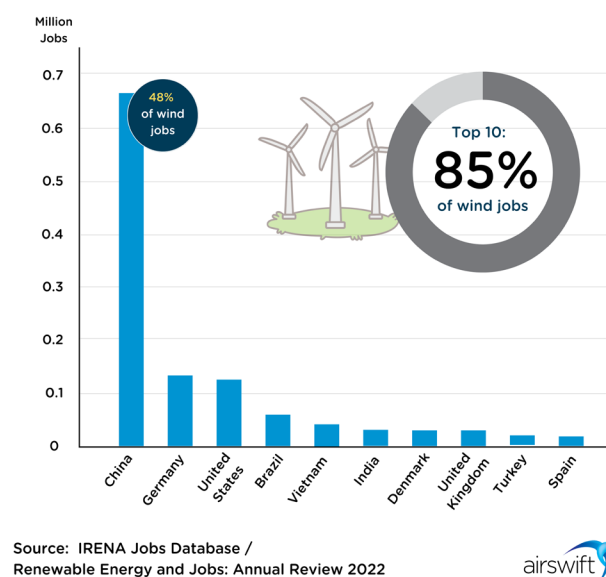
5.1.1 Solar photovoltaic (PV)

Solar photovoltaic (PV) is the fastest growing sector and the largest employer within renewables, accounting for some 4.3 million jobs in 2021 — a third of the total renewable energy workforce.

The world produced 132.8 GW of solar PV capacity installations, with China leading the way (53 GW) of the 2021 additions, followed by the United States, India and Brazil.

The share of [women working in full-time positions](#) in the solar PV industry is 40 per cent. This is almost double the share in the wind industry (21 per cent) and the oil and gas sector (22 per cent).

Figure 14: Wind employment in 2021: Top ten countries.



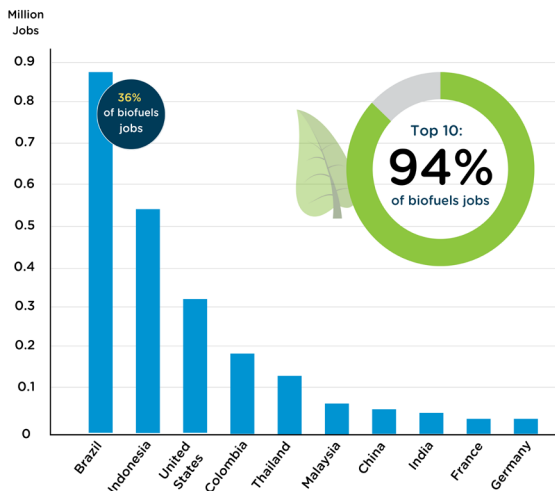
5.1.2 Wind farms

The wind energy sector installed 93 GW of capacity in 2021, the second largest annual addition after 2020. China produced 47 GW, followed by the United States with 14 GW.

Brazil, Vietnam, the United Kingdom, Sweden, Turkey, Germany, India, and France were other leading installers.

Global employment in onshore and offshore wind grew to 1.4 million jobs in 2021, up from 1.25 million in 2020.

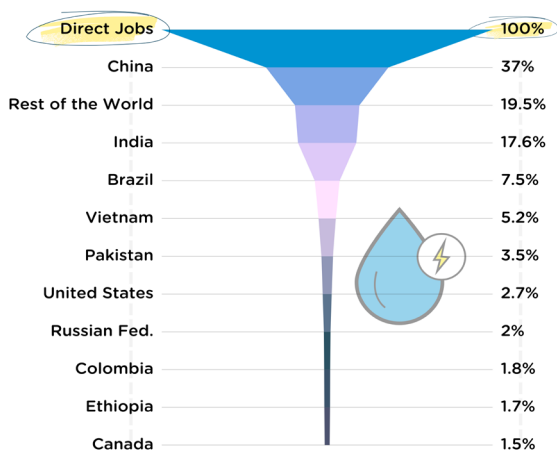
Figure 15: Liquid biofuels employment in 2021: Top ten countries.



Source: IRENA Jobs Database /
Renewable Energy and Jobs: Annual Review 2022



Figure 16: Hydropower employment (direct jobs) by country, 2021.



Source: IRENA Jobs Database /
Renewable Energy and Jobs: Annual Review 2022



5.1.3 Biofuels

In total, 2.4 million people were employed in the biofuel sector in 2021. The production of biofuels recovered from the impact of the COVID-19 crisis, which curtailed energy use for transportation.

The United States and Brazil were the dominant ethanol producers.

For biodiesel, Indonesia was in the lead, followed by Brazil and the United States.

5.1.4 Hydropower

Approximately 2.36 million people worked in Hydropower in 2021. Globally, two-thirds of these jobs were in manufacturing, 30 per cent were related to construction and installation activities, and about 6 per cent were in operations and maintenance service. Global hydropower capacity expanded by 25 GW in 2021.

See below the largest contributors:

- China alone added almost 21 GW
- Canada, India and Viet Nam added about 1 GW each
- European countries added about 1.5 GW

5.1.5 Green hydrogen

Most of the investments dedicated to the energy transition have gone towards solar, wind, and electric vehicles globally. However, **green hydrogen** – hydrogen produced from renewable energy – plays a key role in a clean future.

It is notably recognised in the decarbonisation of hard-to-abate sectors, like replacing fossil fuels in non energy processes and products, such as steel, fertilisers, and plastics production.

But how can hydrogen help achieve a clean, secure, and affordable energy future? According to the **World Energy Transition Outlook** (IRENA, 2021), green hydrogen and its derivatives will account for 12 per cent of final energy use by 2050.

Together with electricity, it will represent 63 per cent of final energy consumption.

Hydrogen Roadmap Europe, a recent study developed with input from 17 leading European industrial actors, believes that hydrogen can account for 5.4m jobs by 2050.

In 2017, only Japan had a national hydrogen strategy. Since then, more than **30 countries** have developed or are preparing hydrogen strategies, indicating growing interest in clean hydrogen value chains.

In July 2022, Australia launched the **Hydrogen Industry Workforce Development Roadmap 2022-2032**. The document builds a pipeline of skilled, hydrogen ready workers and sets out a range of short, medium, and long term actions.

By 2025, countries representing more than 80 per cent of global GDP are expected to have their hydrogen strategy.

Figure 17 shows countries where national hydrogen strategies are in place or in preparation. China, European Union, India, Japan, Korea, and The United States are some frontrunners leading the market.

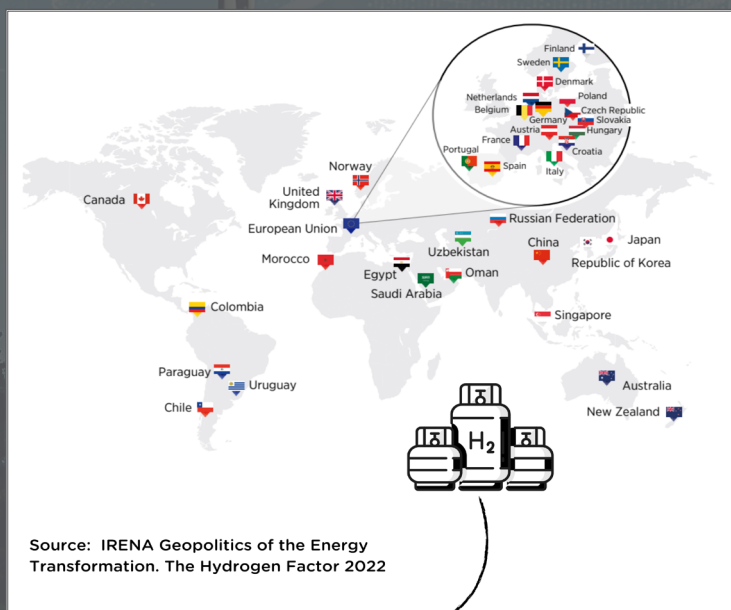


Figure 17: Hydrogen strategies and those in preparation.

Airswift's Regional Director, Ryan Carroll, attended the Australian Clean Energy Summit when the [workforce roadmap](#) was launched and agrees it is crucial to developing a solid industry.

“From the roadmap, we can see that hydrogen career opportunities will be far reaching, from design and construction through to manufacturing, transport and export. So, whilst cross-skilling and upskilling will be required for many of the technical roles producing hydrogen in Queensland, the industry will also create many new jobs throughout the supply chain where this may not be necessary.”



Ryan Carroll
Regional Director at Airswift

5.2 Emerging clean technologies

It is a unique moment to witness the emergence of technologies that will define the course of our relationship with the environment. The energy sector can still incorporate much of the technology industry, including its disruptive management models.

Innovation has become commonplace in this market. It has already changed a sector that was considered traditional but has always been run by technology.

Let's take a look at some of the emerging technologies that are making a difference in our environment today and into the future.

5.2.1 Carbon capture

The perhaps lesser known technologies of carbon sequestration, afforestation, and direct air capture are part of the collective commonly called [carbon capture](#). These solutions aim to “capture” the carbon dioxide emitted into the atmosphere from fossil fuels.

The capture of carbon gases falls into three categories: post-combustion, pre-combustion, and oxy-combustion.

Pipelines and ships are transport formats for this gas, while solid storage and deep geological formations have been recommended for storage .

In the context of climate change mitigation, it has been argued that the use of such technologies would be more effective than other approaches because they do not require any changes to existing infrastructure or energy production processes.

In addition, they could be implemented at relatively low cost. As a result, there is growing interest in the potential for carbon capture and storage (CCS) technology to play an important role in reducing greenhouse gas emissions from fossil fuels.

5.2.2 Batteryless IoT sensors

With the arrival of the Internet of Things (IoT), a question arises: how do we keep so many devices charged and running at the same time?

That's where batteryless IoT sensors come in. These devices draw power from the surrounding environment through electromagnetic signals or small solar cells, allowing a massive scale application.

The potential of this technology can be transformative for many industries around the world. In healthcare, for instance, the use of tiny wearable devices not much larger in size than a band aid, can be used to collect health metrics and monitor heart rate and body temperature. It can even track symptoms of Parkinson's disease and send

that data to the patient's smart device or their healthcare professional. Best of all? All of these products are batteryless.

In addition to the above applications, there is also an opportunity to create new business models by using batteryless IoT sensors. B2B companies could sell access to their sensor networks to other manufacturers who want to monitor their product quality or production processes.

The possibilities of this technology are exciting, and we are sure to see more innovations coming out of it in the near future.

5.2.3 Electric vehicle charging infrastructure

Electric vehicles are no longer a production of the few. Now, even established, century old companies like General Motors are investing in EV research and development.

It is obvious that for this market to expand, an entire infrastructure is needed to support the new model of sustainable mobility. The Electric Vehicle Charging Infrastructure is the solution for us to advance the adoption of electric transport on an increasingly commercial scale.

An excellent example of a company in this market that has been causing business disruption

is [ChargePoint](#), one of the leaders in the segment capable of serving both the B2B and B2C marketplace.

5.2.4 Nuclear fusion energy

An emission free, safe energy source that can be deployed worldwide is nuclear fusion energy, and its potential is so tremendous that we could be saying goodbye to our fossil fuel dependence.

More research and development is needed to speed up adoption of nuclear fusion energy, but investments for this are not lacking. Bill Gates is one of the most enthusiastic investors regarding this type of energy. He is currently backing Commonwealth Fusion Systems (CFS), one of the most well known startups in the niche, and believes that this technology will not be available until the 2040s.

Of course, when promoting the technology, the word “nuclear” can have a bad reputation, but it’s a common mistake to relate this with an unsafe source.

Fusion is not fission, so it doesn’t work based on a chain reaction, and the only shared relation is when dealing with the nucleus of atoms. In short, nuclear fusion energy may need a bit of rebranding before the general population feels comfortable adopting the use of such technology.

5.2.5 Lithium extraction technology

[Lithium](#) demand will triple by 2025, according to [S&P Global](#). This will continue to reveal opportunities for mining innovations of this battery metal.

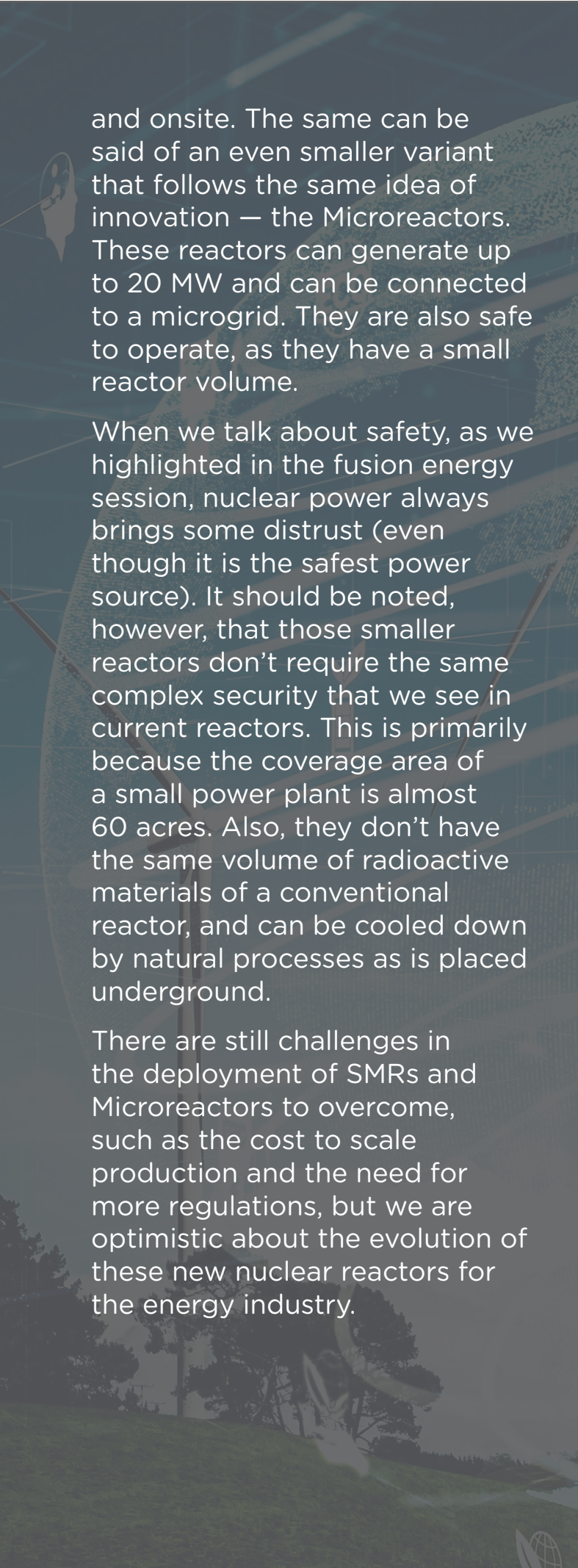
The biggest challenge is being able to mine large amounts of lithium using less water. However, it seems that companies are on the right track, as the price of the Li-ion battery fell 89 per cent between 2010 and 2020.

BloombergNEF [reported](#) that the price in 2010 was above 1,200 dollars per kilowatt-hour. In 2021, the battery pack was already costing 132/kWh dollars. This also indicates a 6 per cent drop from one year (2020) to another (2021). This is certainly excellent news for the EVs market, which can improve affordability for the end consumer.

5.2.6 SMRs and microreactors

With a power capacity of up to 300 MW per unit, Small Modular Reactors (SMRs) have a smaller footprint and can be prefabricated to serve remote regions, making them much more affordable. In 2021, China’s Shandong province received the world’s first commercial onshore small modular reactor. The nuclear power source has 200 MW of capacity.

This type of technology has been gaining notoriety for its ability to be produced both offsite



and onsite. The same can be said of an even smaller variant that follows the same idea of innovation — the Microreactors. These reactors can generate up to 20 MW and can be connected to a microgrid. They are also safe to operate, as they have a small reactor volume.

When we talk about safety, as we highlighted in the fusion energy session, nuclear power always brings some distrust (even though it is the safest power source). It should be noted, however, that those smaller reactors don't require the same complex security that we see in current reactors. This is primarily because the coverage area of a small power plant is almost 60 acres. Also, they don't have the same volume of radioactive materials of a conventional reactor, and can be cooled down by natural processes as is placed underground.

There are still challenges in the deployment of SMRs and Microreactors to overcome, such as the cost to scale production and the need for more regulations, but we are optimistic about the evolution of these new nuclear reactors for the energy industry.

5.2.7 Concentrated solar power

Concentrated solar power

(CSP) has great potential as a renewable source, as it can concentrate the sun's rays at a certain point.

The concentrated sunlight is reflected through mirrors into a receiver, thus heating a high temperature fluid inside.

The heat from this fluid can then power an engine, generating electricity. Utilising this thermal process, it is much easier to store energy compared to electrical solutions such as batteries, that are comparatively less cost effective.

6.0 What does the future bring?

While the climate tech community shows signs of an optimistic future, such a future will not be immune to challenges. We are in a moment where scalability is the million dollar word for the green economy.

The scenario for sustainable technologies is taking shape, and many investments have focused on amplifying the potential of innovative solutions supported by the market and public sector.

It is inevitable that some technologies stand out from others and carry greater future expectations.

Dr. James Custer, 8 Rivers' Chief of Staff, mentioned one of their products that has achieved this distinction.



“We have a couple of marquee technologies. The one we’re most known for at large is called the Allam-Fetvedt Cycle.

It’s a zero emissions power cycle, which takes in carbonaceous fuels and produces just CO2, water and power.

We can store all of that CO2 underground and provide zero emissions baseload power. It can also integrate with renewables to work as a chemical battery.”



Dr. James Custer
Chief of Staff at 8 Rivers

In addition, more and more people agree with the potential of the technology, not only for now but for years to come, as Will Bernholz, 8 Rivers' VP Marketing, addresses:

“MIT did a [study](#) and put out a report that estimated that by 2100, so in about 80 years, potentially 57 per cent of the world's power could come from advanced gas with CCS technologies, like the Allam-Fetvedt Cycle.

So that's a sense of the potential scale for the technology, as some experts see it.”



Will Bernholz
VP Marketing at 8 Rivers

Below are some of the steps that need to be taken for a new dawn to emerge in the energy industry:

- **Scaling up of clean technologies**, supported by investments for infrastructure more focused on sustainable energy. A strong example is the transport market, which still lacks the necessary infrastructure to deliver hydrogen on a commercial scale.
- **Greater collaboration with academic institutions in the climate tech sector.** Fortunately, there are already initiatives such as the School of Sustainability (Arizona State University), in the United States. The country even offers major degrees in the field of sustainability at 96 universities.
- **Meeting the ongoing change in consumer behaviour.** Recently, consumers' adhesion to electric cars has been one of the success factors in the industry. As semiconductor costs continue to decline, it seems that this market will be even bigger in the coming years.

7.0 Facing industry challenges

With such significant challenges, the solutions fall on capital and the workforce.

The public agenda is a great ally in this moment of acceleration of climate tech startups. And that's why the market must take advantage of public sentiment to bring innovative clean technologies.

It is not easy to overcome challenges, especially because much of what has been developed falls within the field of deep tech. Therefore, it is completely understandable that such solutions require time and ample scientific research to reach the consumer's daily life.

Energy companies need to be efficient in their search for the best talent and in their investment pitch. Innovation is building collaboration, and this is how we will reach the net zero scenario in 2050.

Finding more talented people and the highly skilled ones will be fundamental to change our climate situation faster, as addressed by Dr. Custer of 8 Rivers.

Dr. Custer also points out the importance of counting on a partner to help with this expertise in finding the best talent.

"To actually reach net zero, some companies are calling for USD \$50 trillion between now and 2050. Massive numbers.

To do that you need a large amount of people to be executing.

So, finding the right people is going to be the name of the game."



Dr. James Custer
Chief of Staff
at 8 Rivers



“The energy transition isn’t about just building solar panels, right? It’s a much more holistic thing.

There are a lot of issues that need to be addressed. You have to reduce emissions and deal with them directly as they’re created.

So having a partner with a broad knowledge base across all of the different industries that touch the energy transition is perfect and exactly what we need to accelerate our hiring and reaching net zero.”



Dr. James Custer
Chief of Staff at 8 Rivers

8.0 Conclusion: takeaways for candidates and business leaders in energy

This white paper investigates the talent required in the renewable energy industry and new clean technologies that will support the energy transition.

The energy transition will unlock millions of jobs worldwide

The energy transition is underway and brings deep structural changes that will significantly impact economies and societies.

The number of jobs in the energy sector could rise to 139 million jobs in 2030, including:

- 38.2 million workers in the renewable energy industry.
- more than 74 million in energy efficiency, electric vehicles, power systems/flexibility and hydrogen.

The [workforce](#) plays a central role in supporting the continued acceleration of clean energy generation expected in upcoming years.





Technology is the key to meeting net zero

Experts agree that digital transformation holds tremendous potential for accelerating the adoption of green technologies.

Tech is now everywhere, changing the way we produce, work, and consume electricity. But it still faces challenges.

Tech talent is highly sought after within the renewable energy industry, and there is a lot of work to do regarding digitisation. But these jobs are an excellent fit for professionals on the lookout for roles in an innovative industry that is intent on safeguarding the planet.

Cleantech talent and green skills in demand

The future of work is green, and the time to create a tomorrow ready [workforce](#) is now.

Employers seek a wide range of green skill categories, such as sustainable development, environmental policy, ecosystem management, and renewable energy generation.

The biggest challenge is to equip workers with the future skills required to meet this growing demand, as we see job postings requiring green skills increasing faster than the share of green talent.

The tech workforce should have strong math and data analysis backgrounds and be able to manage themselves and collaborate with a diverse team.

To attract and retain this talent, energy must compete with the Information and Communications Technology (ICT) and Healthcare sectors.





Unlocking the needed skills

There is a high demand for talent in the cleantech energy industry but a lack of experienced field technicians, engineers, and tech skills professionals.

Many schools offer courses to train generations of workers specialising in creating and dealing with environmentally friendly solutions, such as MIT Energy Initiative, Robert Gordon University, and Cleantech Institute. Also, bootcamps offer an excellent method for learning quickly.

Another strategy is to take advantage of the oil and gas professional's experience. They are a vital resource to the renewable energy industry and are in a strong position to work within offshore wind, hydrogen fuel, and carbon capture technology due to their many transferable skills, especially in project management, engineering, construction, finance and operations.



ESG, market maturation, and government challenges

Environmental, Social and Governance (ESG) is becoming an increasingly important part of corporate governance and can help companies plan initiatives such as sustainable development, ethical green businesses, carbon reduction, and even talent retention.

Companies are looking for talent with a green philosophy and working experience in sustainability related areas. The maturing of the renewables market is an important point to highlight.

Technologies that were once elusive are now presenting themselves as an integral part of our reality. And, of course, changing consumer behaviour plays an important role in this. Electric cars, for example, are no longer an exclusive commodity, and several companies have emerged, presenting solutions in the entire context of sustainable mobility.

No wonder, as of 2017, the electric private charger market has grown by more than 600 per cent in value worldwide. More information on consumption patterns can empower consumer engagement while opening the way for technological advances, products and services.

Governments also play an essential part in supporting the cleantech job market. They can choose from a wide range of policy interventions and financing measures to support the transformation.



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