Group Laprosolda

ABS

SUSTAINABLE DEVELOPMENT GOALS

ABS, Uberlandia Federal University and Brazil's National Welding Capability and their significance to the UN Sustainable Development Goals (SDGs)

Report by:
Chris Smallbone, IIW President 2005-2008, IIW Fellow
Luiz Paes, Professor, Uberlandia Federal University

June, 2022

Publisher

Universidade Federal de Uberlândia
Av. João Naves de Ávila, 2121, Bairro Santa Mônica
Uberlândia, Minas Gerais
June, 2022

Tel: +55 (34) 99109-2085
Email: d.almeida@abs-soldagem.org.br (Daniel Almeida)
luiz.paes@ufu.br (Luiz Paes)

About ABS and UFU

ABS was founded in 1979 to bring welding professionals together to accomplish the following objectives:
1 – Promote the development of welding technology
2 – Spread welding knowledge through technology transfer
3 – Offer training at different levels of personnel
4 – Promote conferences related to the field for industry and academia
5 – Establish partnerships with different institutions
6 – Create a specialized welding journal

All these objectives were accomplished and today ABS is a reference for welders, inspectors and engineers amongst others.

The **LAPROSOLDA**, located at **UFU**, was created in 1992 with the focus on joining, repair, deposition and related technologies. Since then, it has consolidated nationally and internationally and produced over 1200 articles, 150 vivas, 60 innovation products and 5 books;

Over one hundred projects have been carried out supported with government and company funding and based on the academic and industrial experiences of its staff and researchers. Various accreditations have been received in recognition of its staff, students, equipment, facilities and infrastructure.

Disclaimer

To the maximum extent permitted by applicable law, UFU will not be liable for any indirect, incidental, special, consequential, or punitive damages, or any loss of profits or revenues, whether incurred directly or indirectly, or any loss of data, use, goodwill, or other intangible losses, resulting from: (i) your access and use of the services and products of UFU; (ii) your implementation of any technical or other advice and/or information supplied by UFU (iii) your interaction with members of UFU.

Copyright

Introduction

The Brazilian Welding Association (ABS), the Center for Research and Development of Welding Processes (LAPROSOLDA) at the Uberlandia Federal University (UFU) and the Brazilian government are supporters of the United Nations (UN) 2030 Agenda to continuously improve, both locally and globally, the 17 UN Sustainable Development Goals (SDGs) agreed to by world leaders in 2015. https://en.wikipedia.org/wiki/Sustainable Development Goals

Brazil had been very successful in its achievements in the **UN Millennium Development Goals (MDGs)** responsible for major advances in promoting human development during 2000-2015 [1].

In 2017, Brazil was part of the 2017 voluntary national review of the high-level political forum on sustainable development. By analyzing the relationship between the programmes, goals, targets and initiatives of **Brazil's 2016-2019 Pluriannual Plan** and the 169 targets of the Sustainable Development Goals, it became possible to identify the current alignment between the UN 2030 Agenda and the Brazilian government's main planning instrument.

The UN has 193 countries as members and the aim is to improve the quality of life particularly in low and medium income countries. Each UN country is encouraged to measure its progress on an annual basis against the targets and indicators set against each SDG. For example, **Brazil's Voluntary National Review (VNR) Report 2017** with its central theme to eradicate poverty and promoting prosperity in a changing world [1].

Many of the Brazilian government's flagship programmes and key government departments were at the core of the SDGs. For example, in 2016, it created the National Commission for the Sustainable Development Goals in light of the challenges posed by the new Agenda. This would provide an essential institutional coordination mechanism for achieving the SDGs.

Brazil focused on SDGs 1,2,3,5,9,14 and 17 particularly since the levels of poverty, inequality and unemployment are high (national unemployment is currently over 11%) especially among the youth, women and black people. Along with many countries, the Covid-19 Pandemic has had a negative effect on the 2020-2021 period. It is ranked 61 out of 165 countries which have reported as shown in the Global SDG Index link below.

There is also considerable concern now that many of the government policies and agreements to achieve the UN 2030 Agenda may be changing such that the objectives of this might not be achieved [2].

The **SDG Brazil Index** report can be accessed with the full Sustainable Development Report 2021 giving the Global SDG Index and country reports on https://dashboards.sdgindex.org/downloads and Sustainable Development Report 2021 (sdgindex.org).

The Brazilian Welding Association (ABS) is a not-for-profit membership based organisation and the Uberlandia Federal University (UFU) has the largest grouping of welding research facilities and resources in Brazil. ABS and UFU's Departments are working in line with the Brazilian government's national initiatives, to help Brazil to achieve the United Nations Sustainability Development Goals (SDGs) by 2030.

They have excellent national and international networks of individuals and organisations, including the International Institute of Welding (IIW)'s 51 member countries, enabling them to cooperate and collaborate with them and leverage many of the activities, including technologies, required to progress the various SDGs.

As part of the global community, ABS and UFU also embrace collective international action, cooperating where applicable to apply global solutions to global challenges.

A key objective of this report therefore is to act as a catalyst to create a quantum leap in the amount of projects within each SDG which ABS, UFU and the Brazilian welding Industry's networks could do in cooperation and collaboration with Brazilian governments, industry and aid agencies to achieve the UN SDGs by 2030.

The link to a paper titled "Your Country's National Welding Capability (NWC) and its significance to the UN Sustainable Development Goals (SDGs)" by Chris Smallbone, International Institute of Welding (IIW) Past President, allbones@iinet.net.au contains many examples and references to various initiatives across welding-related fields which have been, or could be, introduced for all 17 UN SDGs [3].

If you wish to discuss such ideas further, including you and your organisation's possible contributions to ABS's and UFU's initiatives on the SDGs, contact Daniel Almeida, ABS Executive Director, d.almeida@abs-soldagem.org.br or Prof Luiz Paes, luiz.paes@ufu.br.

The Importance of ABS's and UFU's work on Brazil's National Welding Capability (NWC) and Links to the UN SDGs

Welding technology is an enabling technology used across almost all industries in Brazil and a wide range of applications, from micro-joining of medical devices, electronics and photonics, to larger scale applications such as bridges, buildings, ships, rail, road transport, pressure equipment and pipelines. The importance of welding to national economic performance can be shown in numerous ways [4].

It encompasses the total life cycle of welded products/structures including design, manufacture, conformity assessment, inspection and testing, operation, maintenance, repair and decommissioning including recycling and other environmental conditions. It is critical to the infrastructure of any country.

The welding industry is defined as those organizations and people:

- involved with the total life cycle of welded products/structures including design, manufacture, conformity assessment, inspection and testing, operation, maintenance, repair and decommissioning including recycling and other environmental conditions;
- engaged in, or employing, any of the organizations or people involved above;
- supplying welding equipment or consumables or materials to be welded; and /or
- involved with education, training, qualification, certification, research and development, work health and safety (WHS), standards and industrial relations aspects of welding.

ABS and UFU, together with their networks, have worked for many years on improving the nation's National Welding Capability (NWC) [5]. They can also show many examples of NWC initiatives that have been implemented both nationally and globally to significantly progress the UN Sustainable Development Goals (SDGs) and improve the quality of life of people and the environment in Brazil and other countries.

Such initiatives include amongst others, education, training, qualification and certification of personnel to both national and international standards, assisting companies to meet exacting standards of customers, R&D and technology transfer. Both organisations also assist in improving education and training to increase self-sufficiency and diversity in skilled personnel in Brazil and other South American countries.

ABS has also been a great supporter of the International Institute of Welding (IIW) and its initiatives to improve the global quality of life [6].

Examples of some initiatives are shown below for each SDG although many SDGs are also interlinked. Hopefully, the examples given under each SDG will lead to mutually beneficial projects between ABS, UFU, the different tiers of government in Brazil, the welding industry and aid agencies.

SDG 1 End poverty in all its forms everywhere

The challenges facing Brazil including from geo-political and socio-economic viewpoints are immense. More than 12% of Brazil's 215 million people live below the poverty line and the unemployment rate is over 11%. 6.5% of people have salaries below US$ 1.9 per day and 25.3% below US$ 5.5 per day. Six out of 26 States have unemployment below 6% and nine out of 26 have above 14%.

As the Brazilian government has identified, ending poverty in all its forms is a multidimensional challenge involving many of the SDGs. Besides increasing the monetary income of the poorest, it is necessary to overcome all the other deprivations derived from poverty. Improving Brazil's productive capacity through better access for the poor to transportation, infrastructure, energy, basic sanitation, improved housing conditions amongst others is acknowledged as a key challenge to eliminating poverty [1].

ABS, UFU, the welding industry and their networks could assist in finding solutions to meet some of these challenges through the implementation of welding and related technologies, creating more job opportunities, reaching out to far greater numbers of people than in their current networks, creating greater educational opportunities and career paths.

The vast majority of people in Brazil simply want a decent job, food, education, health, safety and security and a roof over their heads for their family as well as a decent environment to bring up their children. The ABS and UFU initiatives help progress such aspirations.

Over the years, ABS and UFU have been able to show the value and benefits of their work and the outcomes of that work to Brazil. Many of the examples and initiatives developed by them over the years contribute to ending poverty and improving the quality of life.

Industrialization through manufacturing and construction can lead to economic growth – and most importantly – with the creation of quality jobs with a high labour absorption rate. In metals manufacturing and construction, welding is the enabling technology that allows these activities to take place. Welding, as a career choice, is able to absorb unskilled, poorly educated people and give them in-demand, well-paid, high quality jobs as well as through further education and training, give them career paths to even better opportunities in the welding industry.

Although there are still problems with the adoption and impact of Industry 4.0 in Brazil, both ABS and UFU are also now focusing on the introduction of Industry 4.0 which if successful is anticipated to give unprecedented transformation to Brazilian industry. The introduction of new and appropriate technologies besides saving time, will boost productivity, reduce waste, expand business models and be more responsive to fast changing environmental and consumer demands which will all contribute to the improvement of the quality of life.

A key challenge will always be to be able to combine environmental conservation with job and income generation.

SDG 2 End hunger, achieve food security and improved nutrition, and promote sustainable agriculture

Brazil is fifth in the world rankings for levels of agricultural production mainly due to significant growth due to improved technology and mechanisation even with only a small growth in the total area being utilized.

The Brazilian government has a set of public policies focused on combating hunger and food insecurity, ranging from social protection policies, especially income transfer programmes, to specific policies to foment agricultural production, through credit provision and public programmes for procuring the production of family farming [1].

The **National School Meal Program (PNAE)**, allocates 30% of the funds for purchases from family farmers for the provision of meals to more than 40 million students in basic education, in addition to stimulating healthy nutritional habits.

This is critical for the country since astoundingly cheap investments made today in better nutrition for children can lead to better education and more productive adult lives. Research in Ghana and Malawi has shown that with this approach, it can cost as little as $US5 per mother and yet save lives and transform lifelong prospects so that each dollar spent delivers $US36 of social returns [7].

Poverty in Brazil has markedly rural traits. The reduced access to land and income by small farmers is historically associated to the land concentration prevalent in the country, to very low rates of labour formalization and to the scarcity of public services in rural areas.
Policies aimed at small rural productive units, over four million establishments countrywide, have built strategies for overcoming poverty [1]. The **Program for Food Acquisition from Family Agriculture Production (PAA)** also supports this.

Although there are many factors which can produce hunger in the population in a country, if one considers some of the elements required to assist a country to be able to grow, harvest, store, process and distribute food, welding can assist at each stage in ensuring success and add value to a country's food production needs and hence reduce the probability of hunger.

At the planting, growing, irrigating and harvesting stages there will always be a need to assemble, install and repair equipment such as tractors, tilling equipment, planters, balers, combines, ploughs, mowers, harvesters, grain and feed handling, dams, sprayers and irrigation equipment. Similarly, with storage and distribution, storage and drying equipment, boiler and boiler components, scrubbers, fans, pumps, conveyors, gear boxes and turbines as well as forklift trucks, pallets, lorries.

Even if one is in a region of subsistence farming, collective farming or individual large farms, access to skilled people and equipment is essential both to make components and perform repair and maintenance using welding.

The welding industry can supply significant support to farmers of all categories through the provision of facilities, equipment and consumables for the maintenance and repair of agricultural equipment and plant.

A key objective therefore should be to train as many people as possible in the area in the appropriate welding skills and knowledge for any eventuality which may arise. In many developing countries however, opportunities to attend such colleges are often not readily available. The challenge, therefore, is to assist farmers often in remote rural areas to be able to access such training and obtain the necessary skills.

Some innovative ideas over the past four decades in countries such as Australia and the US have involved mobile practical welding training centres that can be driven to all areas accessible by road. The availability of welding supply companies to offer technical advice and welding supplies to such farmers is also critical. Timing is very important since the farmer cannot wait in the middle of planting or harvesting to fix machinery. Transfer of appropriate technology to farmers is much easier today due to the more acceptable forms of communication such as the latest welding news, blogs, podcasts, virtual conferences, online courses, and digital tools designed to help people grow and succeed

Such people can also use the skills and knowledge for non-agricultural purposes as well and develop other businesses in the rural areas as well as increase the opportunities for employment in various industries. There could be many opportunities at the micro-enterprise level to develop true entrepreneurial cultures. In fact, the number of “micro entrepreneurs” in Brazil has been increasing each year with over 10 million now being registered.

Brazil has excellent opportunities for promoting “start-ups” in many areas both urban and rural. In the welding field this could include youth starting with acquiring basic skills in welding through to engineering personnel with degrees and diplomas. The resources required to train such people to operate an SMME (Small, Medium and Micro Enterprise) are readily available and can be incorporated into the welding training courses at the different levels.

ABS and UFU have many examples of how the technologies developed over the years in their networks have helped ensure the reliability of plant and equipment for processing food as well as the reliability and integrity of the food itself thus contributing to food security.

Collaborating with organisations in its networks such as the **Brazilian Stainless Steel Association (ABINOX), the Brazilian Aluminium Association (ABAL)**, **the Brazilian Society of Metallurgy, Materials and Mining (ABM)** and the **Brazilian Society of Mechanical Sciences and Engineering (ABCM),** they have also helped ensure a

competent industry is available using appropriate technologies to be able to build, repair and maintain the relevant plant and equipment for such food processing and food transportation as well as agricultural equipment and facilities.

With respect to food processing, the hygienic requirements of for example, the food and beverage industry place high demands on the welds that hold tanks, pipes and vessels together.

The requirements specified in codes and standards for a high-quality weld and weld surface finish are paramount in the dairy and other food and beverage industries, as the consequences of poor surface and weld quality can be costly and dangerous.

Brazilian fabricators make significant efforts to ensure that both the weld integrity is adequate and that the surface finish meets the specified requirement for hygiene.

SDG 3 Ensure healthy lives and promote well-being for all at all ages

With regard to health, with a universal and free of charge public system, Brazil is in a privileged position to pursue the targets in the SDG [1].

To ensure the continuous well-being of people in the country and continued accessibility to health systems to increase life expectancy, welding and joining technology transfers are needed and contribute to meeting various medical objectives including examples such as those developed and implemented by IIW Members in the ABS networks, for example, related to medical devices, implants, prosthetics [8],[9],[10]. Such technological improvements lead to cheaper and more efficient components, better recovery, reduced surgery times and greater access to the wider population.

The integrity and reliability of the plant and equipment to produce pharmaceuticals, medical gases and medical radioisotopes depend on the availability of competent welding personnel and companies as well as appropriate welding related technologies. Medical radioisotopes are classified as essential products and the Brazilian government both manufactures them and imports them. A number of ABS company members produce medical gases and are involved in installing them into the national networks of hospitals and medical facilities. The criticality of this industry was shown recently by the reported massive needs for oxygen during the Covid-19 crisis

ABS and its members have also played a key role in ensuring that people involved in welding are protected from a health and safety viewpoint. Involvement with many other organisations from industry, government, standards organisations and IIW among others, has enabled the appropriate standards, guidance notes and educational materials to be used throughout the country to continuously improve the well-being of people.

SDG 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Brazil has created and implemented numerous welding related programmes and opportunities within its networks of educational and training establishments such as Universities, SENAI and the vocational education and training programmes, for lifelong learning to take place. ABS and UFU, in conjunction with the International Institute of Welding (IIW), can forge even closer partnerships between higher education institutions and industry and the development of effective, affordable training systems to contribute to national economic development, international competitiveness and the attainment of social goals.

More and more people will therefore be able to access the opportunities in the welding related fields. The IIW programmes have had a tremendous record and reputation for helping welding engineers, technologists, specialists, practitioners, welders, inspectors and designers obtain training, qualifications and certification over the past two decades in 47 countries to enable them to gain employment.

Persuading governments and industry to support the upliftment of disadvantaged people through improved skills and knowledge of welding and Non-Destructive testing (NDT) can also be a positive approach to be adopted in an NWC Project in a developing country.

For example, International Institute of Welding, IIW WGRA/COM, Success Story No 1 illustrates how the Canadian, Dutch and South African governments were persuaded to provide the funding to train and qualify 65 disadvantaged people in NDT at SAIW. As the Success Story states “This wonderful team effort, between three national governments, industry bodies, national welding institutes and South African industry resulted in an outstanding outcome in improving the quality of life and ongoing opportunities for young people” [11].

A number of major training projects involving countries in Latin America and the Caribbean were initiated and supported by the International Atomic Energy Agency (IAEA) through the promotion of advanced inspection techniques and applications in Non-destructive testing [12], [13]. Projects still continue to this day and could be viewed as models for welding related training projects on a regional basis working in conjunction with international and national aid agencies. The IIW programmes would be ideal for such projects.

The development of the International Institute of Welding (IIW) Education, Training, Qualification and Certification programmes and their implementation including the IIW Manufacturers Certification Scheme According to ISO 3834 (IIW MCS ISO 3834) in 47 countries worldwide, illustrates the importance and need for world class personnel and companies to be available in the welding industry in a country.

Since the introduction of the IIW programmes in 2000, 57009 International Welding Engineers (IWEs) have been trained and qualified worldwide, 12341 International Welding Technologists (IWTs), 46067 International Welding Specialists (IWSs), 4087 International Welding Practitioners (IWPs), 29839 International Welders, 15211 International

Welding Inspectors and 230 International Welded Structures Designers and 2740 companies have been certified to the IIW MCS ISO 3834 programme [14].

To ensure compliance with the appropriate accreditations, ABS and UFU would need to have an organisation approved as an IIW Authorised Nominated Body for Company Certification (ANBCC) and an IIW Authorised Nominated Body (ANB) for the qualification and certification of personnel. The new Brazilian IIW ANB and IIW ANBCC could become the IIW qualification and certification organisations to service not just Brazil but other Latin American and Caribbean countries.

ABS and UFU are also supporting initiatives to provide training to disadvantaged individuals across the broad spectrum of welding specialisations and allied technologies. These should be intended to function as a joint effort with industry giving as many young people as possible a chance in life, while at the same time doing as much as possible to alleviate the skills shortage in the country.

To engage youth from elementary and secondary ages across the country, ABS is working on introducing a new welding simulator program which will use virtual and augmented reality to allow students to try welding in a safe, controlled environment while learning about career opportunities in welding and related skilled trades. This may also be included in **Train-the-Trainer** programmes

ABS has also supported many projects on a voluntary basis including improving the image of welding projects. Through the support of welding skill competitions, welded art exhibitions and competitions, ABS is encouraging as many people as possible to take up the art, trade or profession of welding.

All this has contributed to improving SDG 4 in welding related fields in Brazil and with appropriate support can be expanded significantly in many regions.

SDG 5 Achieve gender equality and empower all women and girls

During the Second World War (WWII), in some countries such as the US, Canada, USSR and UK, due to sheer necessity, women and girls were employed in a wide range of employment situations normally fulfilled by men. Similarly, in many developed countries today, due to women and girls showing that they are competent to fulfil the employment roles, they are employed on an equal basis to men. Unfortunately, there may be countries where due to a variety of reasons, this does not apply. There may therefore be a need to change a number of cultures in a country to achieve equality and empowerment for women and girls.

One of the best ways to enable women and girls to show that they are competent to perform any type of work is to show that they have achieved the required qualification and certification criteria specified for a particular type of work or application. At the same time, if one can change the culture which might be having a negative effect on this approach, then it might achieve positive results.

This becomes easier to achieve when a country has developed and implemented a number of cultures including a skills respect culture [15].

Both ABS and UFU have always been involved in supporting programmes in Brazil, such as the **Women and Science initiative,** promoting such cultures and enabling women and girls to enter the welding related fields at various levels and areas such as education, training, research, development and technology transfer accompanied by the appropriate career paths.

The proposed implementation of scholarships and support for STEM initiatives, are examples of how ABS and UFU can work towards gender equality and greater diversity to progress this SDG.

SDG 6 Ensure availability and sustainability management of water and sanitation for all

Clean Water Management is a key issue in any government's strategic policy. A sustainable water environment is critical to all stakeholders in Brazil and hence its national interest. Major restructuring is normally required and strategic challenges could include drinking water quality, water wastage eg, leaking pipes, environmental issues related to effluent discharge and irrigation issues and for industry to meet these challenges in a productive and competitive manner.

Brazil's water resources although abundant, are unevenly distributed throughout the territory. In the Northeast Region, with almost one third of the Brazilian population, there are severe and regular droughts, particularly in the semi-arid region.

Population pressures on the fragile natural resource base, in turn, aggravate the factors leading to desertification. The vicious circle of cause and effect can lead to a scenario of expansion of the areas susceptible to the phenomenon, with impact on agricultural production, which consequently leads to increased poverty for the region [1].

Welding and joining technology transfers could therefore contribute to meeting the national objectives in the following ways:

- Urgent need for Brazil to upgrade its water catchment, storage, treatment and distribution and waste water infrastructure in both urban and rural applications;
- Minimisation of resource wastage and the risks of serious health and supply breakdown due to failing pipes/distribution;
- Maintenance of aging infrastructure.
- The use and benefit of improved welding fabrication and construction technologies which have been shown by numerous examples of plant required for climate-resilient water sources. These are those on which climate variability, such as variations in rainfall, temperature and drought has little or no influence with two of the most significant being desalination and water recycling plants. The ABS, UFU and the welding industry can truly assist the country in this regard.

ABS's networks within IIW have developed and implemented over the years examples of technologies in applications which have led to cleaner, better quality drinking water; more efficient irrigation, less water wastage, more efficient waste water treatment, less pollution, better water capture and increased water resources.

Such inter-relationships between poverty and the environment are also evident where access to basic sanitation, sewage treatment and solid waste management, are not adequate leading to environmental degradation in Brazilian cities as well as having an adverse impact on the health of the population.

The continual transfer of such existing and new technologies into both Brazil and regional countries, as well as training the people to apply them, is paramount for achieving this SDG.

SDG 7 Ensure access to affordable, reliable, sustainable and modern energy for all

The Brazilian energy mix continues to be one of the cleanest in the world. In 2014, almost 40% of the domestic energy supply was derived from the use of renewable sources as compared to 13.2% of the world average. The diversification of the country's energy sources and the increase in the proportion of renewable resources, as well as an approach for greater efficiency in the sector, comprise an essential strategy from both the economic and environmental perspectives as well as being directly aligned with the goals of the 2030 Agenda [1].

Investment in energy infrastructure is also seen as one of the key factors for poverty eradication since the provision of energy in abundance at low cost has always been considered a major factor of human well-being and development.

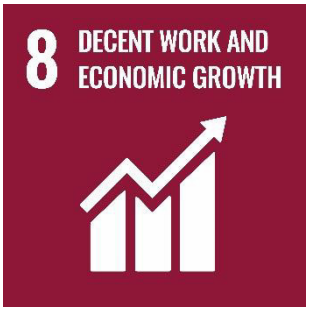
In the past, ABS and UFU and their networks have worked very closely to ensure that there were industries competent to manufacture and maintain the appropriate equipment.

In addition, a major challenge in any transition to "clean energy" with renewable energies such as solar, wind, hydro etc, and other types of energy sources require high quality design, manufacture, maintenance etc.to ensure their reliability and financing to ensure their implementation.

There are many examples of the welding industry's networks being involved in aspects of helping the development of affordable, reliable, sustainable and clean modern energy for the country, including developing industries competent to manufacture and maintain the appropriate equipment.

In the foreseeable future up to 2030 therefore, even with a determined effort to move to cleaner energy sources, existing energy sources will still be in existence and will require the same attention to reliability in service as provided by the technologies, personnel and companies existing in ABS's and UFU's networks and the welding industry.

As the implementation of newer energy sources grows, ABS's and UFU's support for the transfer of such technologies to the appropriate implementers is also growing.



SDG 8 Promote sustained, inclusive and sustainable economic growth

Brazil has the 13th largest economy in the world but based on GDP, the average Brazilian has only 25% of the productivity of an American.

There are many factors which can have a positive effect on the growth of a country's economy. Some of these involve creating the correct cultures within the country. For example, ABS and UFU have had a positive influence on cultures related to ethics, skills respect, productivity, quality, work, health and safety, environment, innovation and service excellence amongst others in the welding related industries. Examples of how these can contribute to an excellent national welding capability can be easily shown.

ABS, UFU and the welding industry, have a positive effect on economic growth. Innovation and the need to have competent people to play their part in innovation also places emphasis on the importance of education, training, qualification and certification of people as well as certification of companies in the country to improve this SDG. These are areas in which ABS and UFU could play even more significant roles.

Implementing strategies to assist companies with new and appropriate technologies, links with education and training organisations and the excellent success of the IIW MCS ISO 3834 company certification programme would all contribute to improving this SDG.

SDG 9 Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation

For successful industrialisation, a country needs a skilled workforce and one that includes welding and related qualified and certified personnel to ensure sustainable industrialisation and provide the ongoing innovation.

Over many years, ABS and UFU, the welding industry and their networks, have been involved in the building up of a vast array of resilient infrastructure in Brazil to world class standards. They have inspired an innovation culture both in themselves and in the country. An innovation culture is where everybody and every effort contributes to bringing in something new, to making changes (ideas, methods etc.) whether in simple or complex forms and includes applying inventions and the adoption of R&D outcomes.

Implementation of innovative ideas and processes especially for smaller firms requires an effective link between the firms themselves and sources of technology. Research and development must therefore link in well with what technology diffusion provides but there must be market awareness of the R&D outcomes if technology diffusion mechanisms are to be effective and increase innovation. ABS, its members and networks, have been at the forefront in this regard

Companies themselves must recognise the importance of new technology to their business, and hence R&D, so that the market demand for new technologies continually improves and the level of technology uptake at the individual company level increases.

The development of sufficient people as both technology deliverers and technology receptors is critical to ensure that innovation can take place. ABS has also been at the forefront of this to world class standards with 153 International Welding Engineers being qualified through ABS.

The development of national and international standards are also essential to ensure the integrity and reliability of welded components and resilient infrastructure. Brazilian industry has helped ensure this through its involvement through ABS being a member of the Brazilian Association of Technical Standards (ABNT).

Welding industry representatives have been involved in many ABNT Technical Committees related to welding and non-destructive examination, pressure equipment, health and safety amongst others and with the participation of a large number of ABS members and allied industry associations.

ABS has regularly over the years organized seminars for the industry dedicated to the development and implementation of new standards and has provided newsletters and posting of information via other traditional and social media on international, regional and Brazilian standards.

SDG 10 Reduce inequality within and among countries

It is important to conduct a needs analysis in a country to establish exactly what is required to improve the quality of life in the country and have solutions to improve equality. In the welding related field there are examples of how such needs analyses have been conducted in a number of countries and then used to put in place appropriate strategies and action plans [16],[17],[18].

For example, ABS has held workshops and congresses on technology innovation and national welding capabilities involving Brazilian and international experts to identify such needs and implement solutions which all contribute to reducing inequality [19], [20], [21]. The CONSOLDA welding national congress is the most important event regarding the welding field and takes place every year. In 2018, UFU assisted ABS in the organization of this conference.

ABS in conjunction with UFU is probably in the ideal position to continue to identify such needs, both in Brazil and other Latin American countries, and provide appropriate solutions. The results which will be achieved will help improve the SDG significantly.

Key ABS, UFU and welding industry initiatives could then be used to grow opportunities in the manufacturing, maintenance and construction industries and create the career pathways for people to improve and help reduce existing inequalities. This could take place on a cooperative and collaborative basis with universities, SENAI and organisations in the Vocational Education and Training system.

SDG 11 Make cities and human settlements inclusive, safe, resilient, and sustainable

As a country, Brazil has the sixth highest population in the world with São Paulo having the fourth largest population in the world as a city. There has been an unprecedented growth of cities and settlements in Brazil over the past seven decades with the need to create safe and affordable buildings including housing as well as safe and efficient public transport. There has also been a growing trend to make such structures resilient to disasters such as fires and floods, as well as failures due to shoddy quality and explosions due to faulty equipment.

Brazil has a major challenge with the rate of urbanisation increasing rapidly in the country and slum proliferation increasing. In the South-East for example, 49.8% of the population live in slums. This also generates environmental problems with social consequences; precarious housing conditions for the poorer populations, often in irregular areas such as riverbanks and hill slopes, making them more susceptible to natural disasters such as floods and landslides.

In Brazil, the welding industry has been heavily involved in developing and applying relevant technologies for use in many applications in human settlements as well as being involved in appropriate organisations related to the metals, pressure equipment and structural steel industry. Developments are taking place to create pre-fabricated affordable housing stock made available by clean and fast welding techniques.

ABS has always promoted the uniform rollout and implementation of the appropriate national and international standards across Brazil to ensure the reliability and integrity of welded structures/products.

With the urgent need to improve the cities, the need for bridges, flyovers and metro tracks is increasing, which also increases the scope of welding in the cities of Brazil.

The certification of fabricators and construction companies to national, regional and international standards to build such products as bridges, flyovers and ‘fast train’ networks is one method the welding industry uses to ensure the reliability and integrity of the wide range of welded products and structures. ABS, working with the appropriate authorities, could introduce the IIW Manufacturers Certification Scheme According to ISO 3834 (IIW MCS ISO 3834) thus helping ensure the competency of Brazilian fabrication and construction companies to create reliable welded structures. Such an initiative will also increase opportunities for local manufacture and increased job opportunities.

Due to the Covid-19 pandemic, IIW Members have introduced virtual audits and training which have proved to be very successful. With the “tyranny of distance” which exists in Brazil, the technologies which have been developed and implemented catering to the challenges of remoteness of both companies and individuals, and in particular poor communities, could lead to more effective training, education, testing and auditing systems in Brazil. This will naturally assist good progress in a number of the SDGs.

SDG 12 Ensure sustainable consumption and production patterns

Brazil has a wide diversity of minerals which can also lead to challenges with mining and processing operations. It is 3rd in the world with iron ore production 10th in steel production 4th in wood production and amongst the top 10 oil producers in the world.

There are many examples of sound environmental and Work, Health and Safety {WHS} management practices around the world to assist in control of many wastes related to welding.

An environmental culture of an organisation could be defined as the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's environmental management.

ABS has been heavily involved in the appropriate Brazilian and International organisations and IIW Commissions in these areas and the transfer of appropriate technologies into industry and the community at large.

Working with other organisations in its networks including ABINOX, ABAL and the Brazil Steel Institute (IABr), the transfer of information on dealing with wastes from the processes involved in the cutting, fabrication, construction of applications using metals is continually taking place via seminars, workshops, guidance notes, education and training courses.

SDG 13 Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy

Energy resources power both domestic and industry needs, and are a key contributor to a country's economic prosperity. The demand for energy increases as a country's economy and population grow. Fossil fuels such as oil, natural gas and coal are examples of non-renewable resources and they cannot be replaced as quickly as they are being used. In contrast, resources that are referred to as renewable energy sources can be used again and again, without depletion, or can be replenished in a short time frame. The wind, sun (solar) and waves are all sources of renewable energy. The welding industry and its networks, have been heavily involved in related work for many years in all these different types of energy ensuring their reliability and integrity and thus having a significant impact on combating climate change and regulating emissions.

Steel is at the core of a green economy, in which economic growth and environmental responsibility work hand in hand. Once the steel is produced it becomes a permanent resource because it is 100% recyclable without loss of quality and has a potentially endless life cycle [22].

ABS, UFU and the welding industry will collaborate with governments and the steel producing industry to meet the challenges ahead including the benefits to the SDGs through the significant growth in steel usage by 2030.

SDG 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development

In terms of challenges below the water, there are many concerns about the whole range of pollution taking place which can have a major significant effect on the marine ecosystems. Since welding is used in numerous applications which will be used in water, the integrity of the welds becomes paramount.

If one considers the range of applications covering ships, boats, oil and gas carrying pipelines and tankers, failures can result for example in fires and oil pollution from small spills to catastrophic damage. The high integrity and reliability of welded structures in marine applications to this SDG is essential. For example, there are over 900,000 boats in Brazil some made of aluminium or steel, and these will require repair and maintenance by welding.

Concern does arise with respect to Brazil's offshore oil industry particularly with the catastrophic failure of an oil platform in 2001 which sank into the Atlantic Ocean off the coast of Rio de Janeiro. Oil started spilling five days after explosions on the giant rig killed 10 workers and damaged the finances and image of Brazil's state oil company.

The importance of the integrity of welding is illustrated by the Alexander L Kielland platform in the North Sea in March 1980 which capsized with the loss of 123 people. The official investigations concluded that the root cause of the accident was an undetected fatigue crack in the weld of an instrument connection on the bracing. It was reported that there was no pollution due to this accident.

When catastrophic accidents have occurred related to oil production platforms and tankers, the effects can be disastrous on animals, birds and marine life. For example, the spill from BP's Deepwater Horizon rig in the Gulf of Mexico in 2010, covered 68000 square miles of sea surface and killed approximately one million coastal and seabirds, 5000 marine mammals and 1000 sea turtles. The long term effects on the environment and animals' health are immense.

The high integrity and reliability of welded structures in marine applications to this SDG is essential. The expertise in ABS's and UFU's and the welding industry's networks, particularly with IIW Members, has been used to mitigate such problems particularly through the development work and involvement of its networks of world class experts, and will continue to do so.

SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Environmental issues in Brazil include deforestation, illegal wildlife trade, illegal poaching, air pollution, land degradation and water pollution caused by mining activities, wetland degradation, pesticide use and severe oil spills among others [23]

Although many of these issues are outside the control of the welding industry, welding is used in many critical applications which if failure occurs, varying degrees of contamination and destruction can take place. These can range from catastrophes similar to those mentioned above in SDG 14 through to issues such as sewage and mining spillages onto land and into rivers which is prevalent in Brazil.

The great benefits of welding, and ABS's and UFU's and industry's efforts, can be realised however with the proper design, materials, procedures, manufacture, conformity assessment, operations including repair and maintenance as well as decommissioning leading to positive contributions to improving this SDG.

In terms of this SDG, welding can also have a positive influence in a number of other ways. In all the issues mentioned, water management plays a significant role in their success. Water sources whether dams, rivers, desalination plants etc, need to be built and maintained. Pipelines need to be constructed, laid and maintained to carry the water to the points where distribution can take place to where the water is required with minimum waste.

In terms of combatting desertification and using the reclaimed land for agriculture as happens successfully in various countries, efficient storage and irrigation methods are essential and the integrity of welding can have an effect on this.

With forest management and remediating land which has been degraded, similar challenges with ensuring reliable efficient water supplies exist. Storage tanks, pipelines, piping systems will all require competent people to apply appropriate welding and inspection technologies.

In addition, reliable heavy moving equipment and other types of vehicles will be required on an ongoing basis. This will require competent welding maintenance workers with the abilities not only to apply the appropriate technologies but also to develop the necessary procedures and application processes often for difficult-to-weld materials.
Brazil is the fifth largest country in the world by total area with 60% (5.5 million sq kms) being covered by the Amazon, the greatest tropical rainforest in the world, with a very broad range of biodiversity. Unfortunately, massive deforestation has been taking place for decades and the previous Brazilian government did commit to restore four million hectares by 2030. It also required municipalities with native vegetation cover, especially those located in the Amazon, to implement strategies for the sustainable use of land and forest management.

In all these cases including biodiversity loss, it is often required to fence-off and protect the land enclosed against feral animals killing off rewilding attempts and damaging the habitat being remediated. Although fencing is one step along

the rewilding path, again welding plays a significant role in ensuring the integrity of such fencing. In Australia for example, there are major moves not just to conserve existing and often quite degraded land areas but to revitalise it. Rewilding is a complex issue.

With the rapid development of welding technology and its links to steel as a 100% recyclable material, some people believe that it is becoming cheaper and faster to make use of metal as a material, hence reducing the load on natural materials such as wood, hence reducing deforestation.

SDG 16 Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective accountable and inclusive institutions at all levels

Often the word "sustainable" is understood by people to refer only to financial sustainability. It is important to realise that it refers to many other aspects of the SDGs, in particular including the environmental and cultural behaviours.

The corruption perceptions index 2021 is high for Brazil with it being ranked 96th out of 180 countries [24]. A major concern is that politicians do not create inclusive societies resulting in the continuation of inequalities.

A useful approach is to look for 'ethical leadership' in people at all levels. The most successful leaders inspire others to embrace a common goal through recognition of shared values. They build and maintain effective relationships by living and leading with integrity.

ISO (International Standardisation Organisation) has also introduced standards which involve ethical behaviour. ISO 19600:2014- Compliance Management Systems-Guidelines and ISO 26000 Social Responsibility Guidance Document.

ISO 19600:2014 covers establishing, developing, implementing, evaluating, maintaining and improving an effective and responsive compliance management system within an organisation. They are guidelines and the extent to which they are used depends on the size, structure, nature and complexity of the organisation. The Standard falls under ISO Technical Committee 309, Governance of organisations.

ABS and UFU are effective, accountable and inclusive institutions. ABS is a member based organisation and is accountable to its members. Through its industry committees, it is accountable to the broader Brazilian industry and being a not-for- profit organisation, it puts the needs of industry and communities first. To succeed in its objectives, it ensures that the organisations in its networks are also effective, accountable and inclusive.

Through their technology transfer mechanisms, ABS and UFU have the ability to significantly influence this SDG positively through the successful promotion and implementation of the above standards in the industry.

SDG 17 Strengthen the means of implementation and revitalise the global partnership for sustainable development

An important component of achieving this SDG is the use of the formal networks which exist within the welding related industries both locally and globally.

Such networks help in producing a multitude of partnerships, both large and small, ready to work together on appropriate activities to assist in meeting SDG targets in a country.

A general definition of a network is that it consists of a variety of entities (e.g. organisations and people) which are largely autonomous, geographically distributed and heterogeneous in terms of their operating environment, culture, social capital and goals, but that cooperate and/or collaborate to better achieve common or compatible goals.

In terms of science, technology and innovation in the welding industry, it is noted that the diversification of the ST&I system is necessary not only through new policies and instruments, but also through new institutional models.

One only has to consider ABS's and UFU's networks such as IIW, ABM, ABCM, ABINOX, ABAL, IABr, ABNT, International Organisation for Standardization (ISO), IAEA, International Committee for Non-Destructive Testing (ICNDT) etc to see the potential which can be harnessed.

Two good example of how such networks can assist with this SDG including ideas on new institutional models are shown in references [25] and [26]. Reference 25 shows how Australia created a worldwide network of technological experts and organisations with remarkable success with technology transfer. Reference 26 shows how the Canadian Welding Bureau (CWB) Group built up an Association from 1000 members to over 70000 members over a ten year period including 20 Chapters across Canada. When one considers the hundreds of thousands of people welding in Brazil, a quantum leap by the welding industry's involvement in progressing the SDGs will make an enormous contribution to the Brazilian government's endeavours.

Since international technical cooperation is an important and diversified modality of Brazil's contribution to the development of institutional and individual capacity of developing countries in Latin America, the Caribbean, Africa, Asia and Oceania, opportunities for greater cooperation and collaboration between countries and regions exist [1].

For example, the formation of a regional technology transfer grouping could result in many technology transfer activities being held in a cooperative and collaborative manner between the Latin American countries. These initiatives could result in outcomes such as funding support from governments and industry for technology support centres in these countries, as well as the transfer to the region of the knowledge and experiences of many world experts across a whole range of critical industrial applications.

Recommendations and future actions

For those people, including their organisations, who wish to support and contribute to the achievement of the UN SDGs, please link to Reference [3] titled “Your Country’s National Welding Capability (NWC) and its significance to the UN Sustainability Development Goals (SDGs)” by Chris Smallbone, IIW Past President.allbones@iinet.net.au.

The paper contains many examples and references to various initiatives across welding-related fields which could be introduced for all 17 UN SDGs. If you wish to discuss such ideas further including you and your organisation’s possible contributions to Brazil’s welding industry initiatives, contact Daniel Almeida, ABS Executive Director, d.almeida@abs-soldagem.org.br or Prof Luiz Paes, luiz.paes@ufu.br

It is the intention of ABS and UFU to draw up mutually beneficial strategies and action plans with the support of Brazilian governments, industry and aid agencies for implementation to achieve significant progress in UN SDGs for which it has the expertise. The formulation of new partnership models that can lead to the success of the SDGs and to sustainable development in partner countries, corresponds unequivocally to the spirit of the UN 2030 Agenda. Through cooperation and collaboration of all relevant organisations, including using tools initiated by the government and civil society to plan and disseminate the SDGs in localised situations, success will result in reaching as many Brazilians as possible[1].

This report is to be a catalyst for such initiatives and create a quantum leap for ABS, UFU and the welding industry to support the Brazilian government to succeed in this major objective by 2030.

References

[1] Voluntary National Review on the Sustainable Development Goals Brazil, 2017, https://sustainabledevelopment.un.org/content/documents/15806Brazil_English.pdf

[2] The Risk of Losing the 2030 Agenda in Brazil, 2nd November 2020, https://sdg.iisd.org>commentary>the-risk-of-losing-the-2030-agenda-in-brazil

[3] Your Country's National Welding Capability (NWC) and its significance to the UN Sustainable Development Goals by Chris Smallbone, IIW Past President. Keynote Paper, ASR International Conference, Resita, Romania, 22-23 April 2021 https://asr.ro/documents/C.Smallbone2021.pdf?_t=1639211760

[4] Macroeconomic and sectoral value added by the production and application of joining technology in Germany, in selected countries in Europe as well as the EU as a whole. Short version of the expert report, Michael Kersting, Waike Moos and Anna Werbeck Ruhr Research Institute, Bochum 2017

[5] SciELO - Brazil - Establishing and Implementing the Building Blocks of a Country's National Welding Capability (NWC) https://www.scielo.br/j/si/a/tDWHcwCpMB3tFYY4xTXWZWt/?lang=en

[6] The International Institute of Welding (IIW), its potential positive influence in the world and some national models for innovation. Chris Smallbone, IIW President. 2nd Latin American IIW International Congress, Sao Paulo, 2008

[7] Christmas charity begins by homing in on those in need, Bjorn Lomborg, The Weekend Australian, 18-19 December 2021

[8] Laser and Plasma dental soldering techniques applied to Ti-6Al-4V alloy: ultimate tensile strength and finite element analysis. Castro et al. The Journal of Prosthetic Dentistry, p1-7,2015 DOI: 10.1016/j.prosdent.2014.10.008

[9] Australia's first 3D printed spine implant https://www.rmit.edu.au>advanced_manufacturing –precinct, 17 August 2015

[10] Medical Device Consulting-Materials and Joining Technology https://www.twi_global.com>medical equipment

[11] IIW WGRA-Com Success Story Number 1 *A team effort between three national governments, industry bodies, national welding institutes and South African industry gives hope to new welding inspectors and a model for the future.*

[12] First Regional Training Course in Latin America and the Caribbean on Non-Destructive Testing for the Evaluation of Civil Structures Takes Place https://www.iaea.org/newscenter/news/first-regional-training-course-in-latin-america-and-the-caribbean-on-non-destructive-testing-for-the-evaluation-of-civil-structures-takes-place#:~:text=Structures%20Takes%20Place-,First%20Regional%20Training%20Course%20in%20Latin%20America%20and%20the%20Caribbean,of

%20Civil%20Structures%20Takes%20Place&text=Eduardo%20Fco.,Nacional%20de%20Investigaciones%20Nucleares%2C%20Mexico.

[13] Non-destructive testing training in Latin America and the Caribbean. C.K. Beswick and J.H. Zirnhelt IAEA Bulletin 2/1988

[14] IAB-International Authorisation Board, Report on IIW-IAB Qualification and Certification Systems Activities during 2020, EWF/IIW-IAB Management Team June 2021

[15] A Discussion Document on creating a culture of Respect for Skills in South Africa. P.J.J. Dorfling, National Productivity Institute, August 1994.

[16] A Comprehensive Advanced Materials Joining and Forming Technology Roadmap-Final Report, Prepared by Tom McGaughy, Hyunok Kim and Harvey Castner, EWI, Columbus, Ohio, 28 April 2017.

[17] Welding Industry Technology Needs Study-Cooperative Research Centre for Materials Welding and Joining (CRC-MWJ), Planning & Managing Projects Pty Ltd, 30 November 1995.

[18] Smallbone, C. and Kocak M., "IIW White Paper: Improving Global Quality of Life Through Optimum Use and Innovation of Welding and Joining Technologies" Published by IIW 2012 http://iiwelding.org

[19] 1st IIW European-South American School of Welding and Correlated Processes,18-20 May 2011,Ouro,Preto,Brazil.

[20] 2nd Latin American IIW International Congress, Sao Paulo, Brazil, 18-21 May 2008

[21] 1st Pan American IIW International Congress, Sao Paulo, October 2014

[22] Environmental issues in Brazil, Wikipedia. https://en.wikipedia.org?wiki>environmental_issues_in_brazil

[23] Sustainable Steel: at the core of a green economy, 31 May 2012 https://worldsteel.org/publications/bookshop/sustainability 2012

[24] Corruption Perceptions Index 2021, Transparency International https://www.transparency.org>cpi>2021

[25] "The OzWeld Technology Support Centres Networks: A Unique Model for Technology Innovation by Industry" Chris Smallbone, Executive Director, WTIA, ASM/AWS 6th International Conference on Trends in Welding Research 15 – 19 April 2002 Pine Mountain, Georgia, USA.

[26] WELD Canadian Welding & Lifestyle Magazine WINTER 2021 Vol 04 No 16.
https://www.cwbgroup.org/association/publications
https://www.cwbgroup.org/association/publications/weld-winter-2021