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WOMEN IN THE REFRIGERATION, AIR-CONDITIONING AND HEAT PUMPS INDUSTRY

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ABSTRACT

Over 15 million people are employed worldwide in the refrigeration sector, which means that almost 5 workers out of 1000 have a job linked to the manufacturing, installation, maintenance and servicing of refrigeration equipment. The need for engineering and technical staff is currently increasing due to the growing demand for refrigerating capabilities, along with the unique skills required from refrigeration-related professions in the field of energy and environment. Women are significantly and visibly under-represented in the refrigeration industry. The preliminary evaluation demonstrated that 6.13% of women are members of national refrigeration associations/organizations/institutions. This paper is an update of the IIR preliminary state-of-the-art of women in the refrigeration field collected from national RACHP institutions and associations. It focuses also on new national, regional and international incentives to promote refrigeration to the younger generation including minority groups such women/girls.
Keywords: Engineering, Diversity, Refrigeration, Women, Youth, Outreach.

1. INTRODUCTION

The refrigeration industry plays a major and increasing role in today's global economy, with significant contributions made in food, health, energy and environmental domains which policy makers need to better take into account. The IIR estimates that the refrigeration sector including air conditioning consumes about 20% of the overall electricity used worldwide and the global electricity demand for refrigeration including air conditioning is predicted to more than double by 2050 [IIR, 2019]. Overall, according to the IIR estimations for refrigeration sector related emissions account for 4.14 GtCO2eq, representing 7.8% of global GHG emissions [IIR, 2019]. Also, the IIR estimates that over 15 million people are employed worldwide in the refrigeration industry, which means that almost 5 workers out of 1000 have a job linked to the manufacturing, installation, maintenance and servicing of all type of refrigeration equipment.
Women are significantly and visibly under-represented in the refrigeration industry. Colombo *et al.* [2018] undertook an evaluation which demonstrated that women represent only 6.13% of the members of national refrigeration associations/organizations/institutions. Those figures were considered to be representative of women in the whole refrigeration industry.

1.1. UN Environment report

UN Environment recently published a report on the personal experiences and achievements of 107 women working in the refrigeration and air-conditioning industry [UN, 2019] in 49 countries. These women work in various specific areas of the refrigeration, air-conditioning and heat pumps (RACHP) sector: HVAC 30%, commercial 10%, industrial 21%, educational 16%, 12% research and 10% in journalism, national and international sectors. Among them:

- 20% had national certificates/diplomas mostly working as technicians
- 19% had higher education national diplomas mostly working as teachers, technicians and company/managing directors
- 29% had BEng/BSc degrees mostly working as engineers, designers, managers, teachers, technicians, company/managing directors.
- 9% had MSc degrees mostly working as teachers and engineers
- 13% had PhD degrees working as researchers, lecturers and managing directors
- 11% did not specified their qualifications but they are working as technicians and a majority have taken RACHP as a new career path. For instance, some secretaries working in a RACHP companies decided to become technicians; some after a long period not working to take care of children found jobs easily in the refrigeration industry; others have been part of a family business in RACHP.
- 20% of the women had relatives and/or acquaintances working in RACHP whom inspired them to work and/or study this field.

This is a non-representative sample and cannot be extrapolated directly, hence the results presented are just indicative of women experiences in the industry.

2. CAREER AND QUALIFICATIONS IN REFRIGERATION

The (RACHP) industry has a vital role in society with its wide range of applications in food, health, industry and leisure. Table 1 summarises the most common applications for RACHP [IIR, 2019].

Table 1: RACHP applications

Applications	**Sector**	**Equipment**	**Location**
Refrigeration and food preservation	Industrial refrigeration	Spiral chiller/freezers, tunnels, etc.	Food processing plants
	Refrigerated storage	Cold stores	
	Commercial refrigeration	Commercial and professional refrigeration equipment (storage and blast chillers/freezers)	Catering: restaurants, hotels, bars Supermarkets
	Refrigerated transport	Refrigerated vehicles and containers	Mobile
	Domestic refrigeration	Refrigerators and freezers	Households
Refrigeration and health	Medicine and pharmaceuticals	Magnetic Resonance Imaging (MRI) machines	Hospitals
		Vaccine refrigerators	
Refrigeration in industry	Liquified Natural Gas (LNG)	LNG regasification terminals LNG tanker fleet	
Leisure and sports		Ice rinks Ski centres	
Heating and cooling		Heat pumps (residential, commercial and industrial equipment, including reversible air-to-air air conditioners)	Households, commercial premises
Air-Conditioning	Stationary air conditioning	Residential air-conditioning units Commercial air-conditioning units Water chillers	Households, commercial premises
	Mobile air-conditioning systems	Air-conditioned vehicles (passenger cars, commercial vehicles and buses)	Mobile

2.1. Careers in refrigeration

The technical careers in the RACHP industry cover the development, installation, service of equipment, sales and management.

2.1.1 Career in product development

- Design and development engineers: work for an RACHP manufacturer to design, develop and test heating and cooling components, technologies and systems to ensure performance and safety. Propose innovative offers to customers.

2.1.2 Career in installation and service

- Technicians: who install the equipment, liaise with the customers/end users, check the quality of the installation and ensure the cabinet settings are correct.
- Service engineers: who analyse malfunctions, repair equipment and ensure equipment maintenance.

2.1.3 Career in sales

- Technical sales engineers: promote and sell equipment to business customers using technical knowledge and commercial training.

2.1.4 Career in management

- Project managers: whom to plan and coordinate product development utilising the necessary engineering, labour, equipment, materials, tools, subcontracted services, and other company resources to effectively perform the scope of work within an allotted budget and time schedule.

Technical careers require an understanding of RACHP fundamentals with practical application, integration with other professions, the ability to communicate effectively with customers /end users and to be prepared to adapt and learn new skills as technologies evolve.

2.2 Qualifications in refrigeration

The IIR is currently developing the IIR Training Directory in which will list the education courses and training for refrigeration industry and has the records of the British and French qualifications. The Route Map to refrigeration and air conditioning qualifications according their national qualifications frameworks are described below:

2.1.1. British qualifications

The IIR has the records of the all British qualifications from level 4 to 7 of the UK's Regulated Qualifications Framework (RQF). Figure 1 shows that currently, there are 4 foundation degrees, 10 Higher National Certificates, 3 Higher National Diplomas, 15 Bachelors of Engineering/Bachelor of Science and 17 Masters of Sciences/Master of engineering establishments.

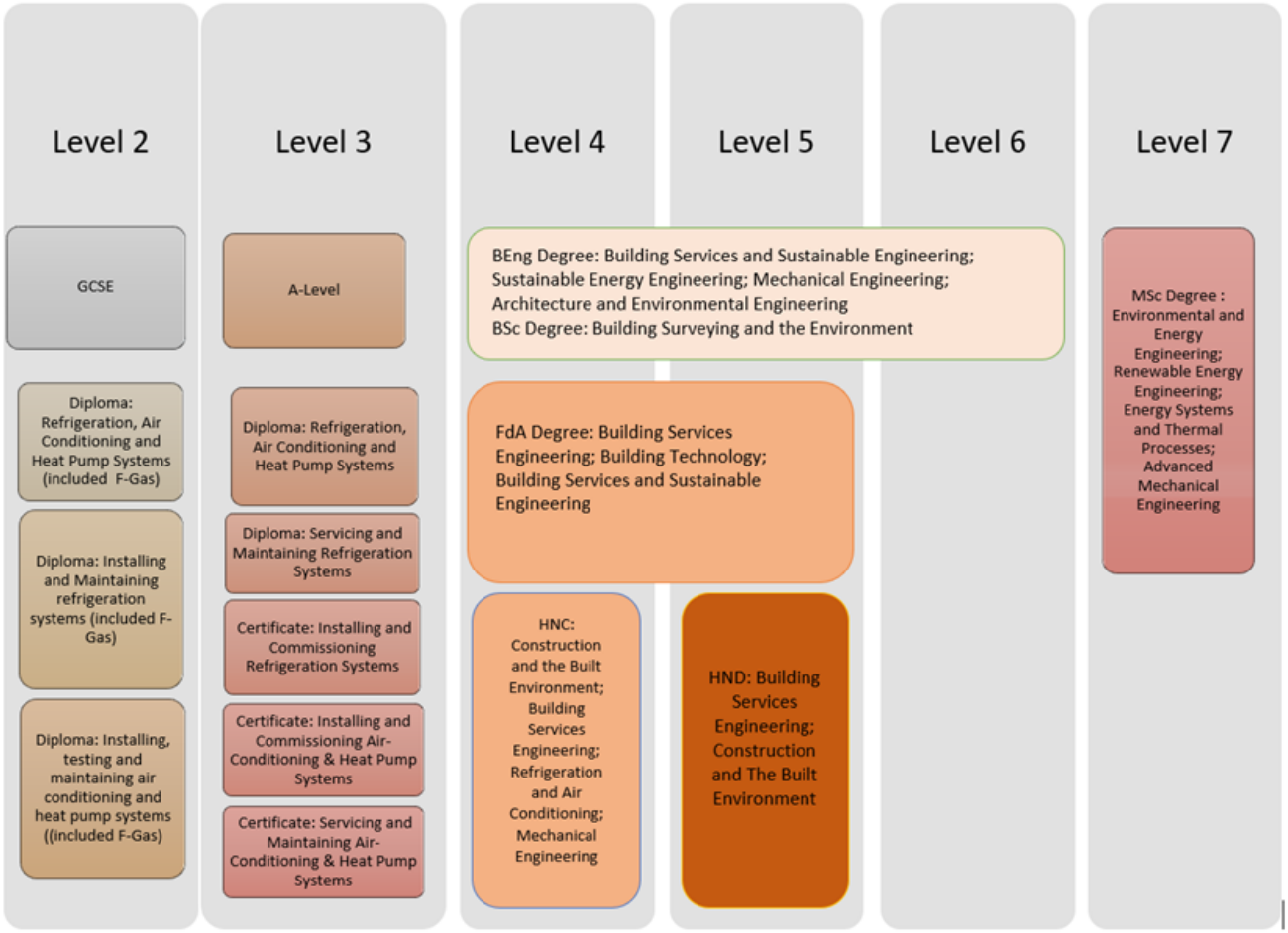

Figure 1: British qualifications in HVAC+R

2.1.2. French qualifications

The IIR has the records of the all French qualifications from level 3 to 7 of the French's National Directory of Professional Certifications [Répertoire National des Certifications Professionnelles (RNCP)]. Figure 2 shows that currently, there are 17 DUT, 20 BTS, 7 professional licenses and 2 masters that teach refrigeration and air conditioning engineering establishments. The Titre Professionnel is a professional certification issued by the Minister responsible for employment. This title attests that its holder masters the skills, aptitudes and knowledge allowing qualified professional activities.

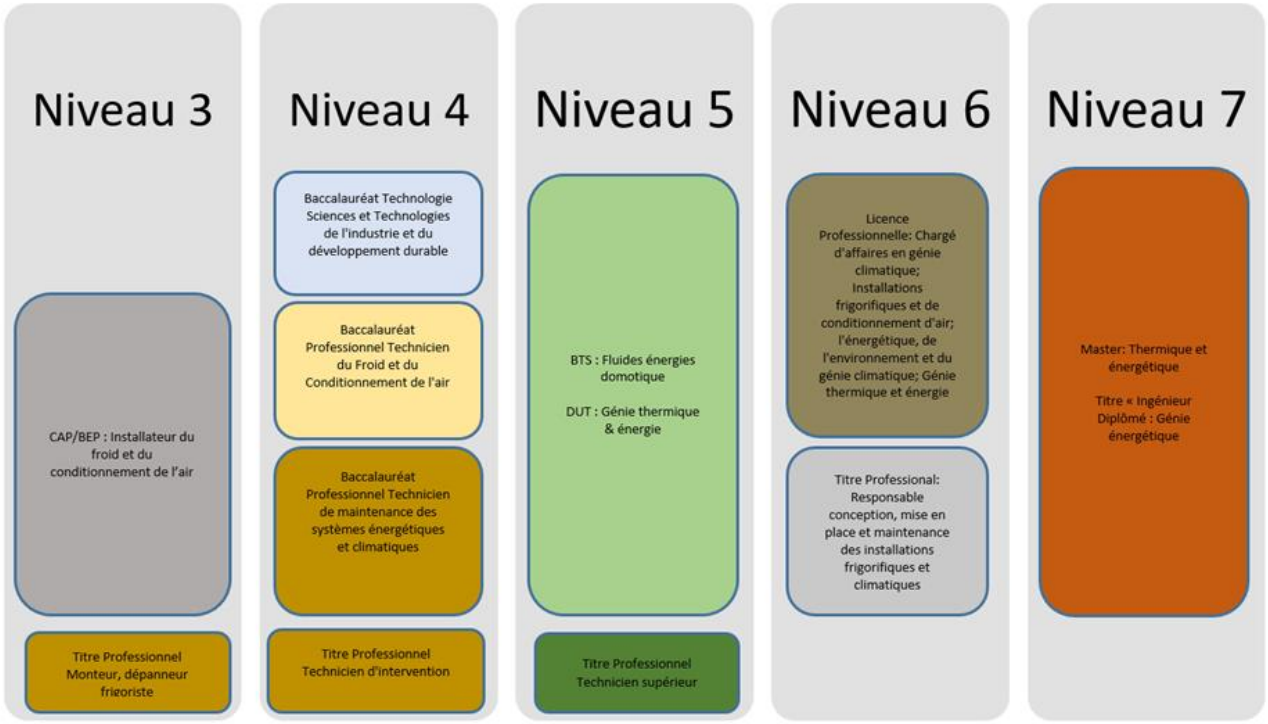

Figure 2: French qualifications in HVAC+R

3. WOMEN IN REFRIGERATION

The initial survey undertaken in 2015 by Colombo *et al.* [2016] has been reviewed and 25 worldwide associations/institutions have been contacted (18 replied) in order to obtain the percentage of women registered as private members of national associations/institutions. Currently this is the only available data to determine women representation in the industry.

3.1. Survey review

The reviewed survey results are shown in the Table 2 below. This time, the following associations: ABRAVA, HRAI, JNC, ACOPROF and ABOK did not provide data, due to lack of reliability in their figures, but new associations provided figures such the APFC and ISHRAE.

Table 2: Women registered as members of national associations/institutions

Country	National Associations	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Australia	AIRAH	3,1%	3,7%	4,5%	7,5%	8,0%
Brazil	ABRAVA	6,3%				
Burkina Faso	APFC				2,5%	
Canada	HRAI	1,7%				
China	CAR	19,5%	19,6%	19,7%	19,9%	20,1%
Congo	ACOPROF	0,1%				
EU	EPEE			16%	18%	19%
France	AFF	7,8%	4,9%	6,6%	6,7%	7,6%
Germany	DKV	5,3%	5.4%	5.4%	5.5%	5.5%
India	ISHRAE		3,0%	3,1%	5,0%	6,0%
Italy	AiCARR	8,8%	9,0%	9.3%	9.6%	<10%

Japan	JSRAE	2,3%	2,3%	2,2%	2,1%	2,0%
New Zealand	IRHACE	1,0%			2,1%	1,9%
Jordan	JNC	8%				
Norway	NKF	2,2%	2,4%	2,6%	3,5%	4,7%
Romania	AGFR	19,0%	20,0%	15,0%	20,0%	
Russia	ABOK	3,0%				
South Korea	SAREK	4,1%	4,7%	4,9%	5,2%	
South Africa	SAIRAC	2,8%	2.81%	3.56%	3.56%	4.12%
United Kingdom	IOR	2,0%	2,0%	2,0%	4,0%	
USA	ASHRAE	6,5%	6,8%	7,7%	8,3%	

The percentage of women registered in the Chinese, German, Japanese and Romanian associations/institutions remained steady over the last 5 years. There was a slight increase of female registrations into Italian and French associations. Some national associations/institutions have significantly increased or even doubled their woman/girl's registrations such as AIRAH (Australia), ISHRAE (India), NKF (Norway), SAIRAC (South Africa), IOR (United Kingdom) and ASHRAE (USA).
The Brussels based European industry trade association EPEE also saw its percentage of women participating in its working groups increase steadily over the past 3 years. In addition, in 2018 the first woman has been elected to the Board of Directors (Steering Committee) of the association.

3.2. Incentives from national associations/institutions

In order to attract more young people and women/girls into the refrigeration/HVAC sector, some national associations/institutions have developed specific strategies. The following sections describe the different incentive/actions undertaken by some associations in different world regions:

3.2.1. Europe

- UK: Institute of Refrigeration (IOR)

Industry and engineering fields know a low presence of females, in the UK only 12.37% of all engineers are women (Engineering UK 2018). Supported by the IOR, the group WiRACHP (Women in Refrigeration, Air Conditioning and Heat Pumps) aims to engage and attract more talented females and make this industry more appealing to all. In order to achieve that, the group adopts measures that follow the objectives set by the IOR. The first approach was to promote the range of available careers and encourage career progression for women through networking, mentoring and learning. Another measure was to share experiences of women working in RACHP in order to create role models that can attract more female talents. This can be achieved through forums and features in magazines, representation at events and also through outreach work in schools and colleges. One good example of sharing experiences and information is the LinkedIn of the group that helps to promote events.
WiRACHP is a non-funded initiative and the marketing is done through social media and networking. In order to have a wider impact, many links have been made to other similar groups through social media (members of Women Engineering Society council have links with WiBSE). The LinkedIn group has now 700 members with 95% of women and the increase of members since its inception in 2016 is very inspiring. The initiative has a positive impact for the institute since it encourages female members to pursuit full IOR membership. At the beginning the WiRACHP network in 2016, the percentage of female membership of the IOR was less than 0,5%. In March 2019 a target was set to increase IOR female membership by launching the 100 for 100 campaign aiming to increase the number of female members to 100 by the 100th anniversary of the Women Engineering Society. The campaign was very successful and the IOR female members doubled and jumped to over 80 due to the campaign and the reduction of the IOR joining fee. Now these females' members of IOR will contribute to make greater impact in the industry. It is noticeable the success of the initiative since more women are nominated for awards such as trainee of the year and two women from the group were named in

the top 50 Women in Engineering Awards in 2019. The WiRACHP acts as a mentor for females and encourages them to join IOR and WES council as well as other groups that aim to change the future of industry. Three successful career development days attended by over 30 women have been completed. Now the IOR is planning for the 4th event in June 2020 to highlight Women in Engineering day. WiRACHP supported many initiatives like the Fantastic Fridges website and supported the 'Cool for School' competition designed to challenge students to explore science, technology, engineering and mathematical principles and come up with a simple experiment or presentation to demonstrate one of these.
The WiRACHP group is well known in the industry and it aims to continue efforts with its steering committee from 12 different companies that are supporting the initiative. Many credits were given to WiRACHP such as the Graeme Fox (BESA) endorsement of the training days and how useful they are to create opportunities for more women to attain technical knowledge as well as experience. The group aims to continue its initiatives to benefit both women and the industry.

- Italy: Association of Air Conditioning Heating and Refrigeration (AiCARR)

The project 'Women in AiCARR' aims to identify the factors influencing the low female presence in the industry and determine some positive actions to increase the number of female associates and promote their active contribution to the association. A survey was conducted on the members of AiCARR that shows 10% female presence. The analysis shows that most females in the association are under the age of 50 and that 40% are below 30. This means that the female membership is characterized by a high presence of young women with professional experience at junior level. Both female and male members of AiCARR can be active elements of change by sharing their professional experiences with the younger generation. Female students in particular can benefit from role models in less well-known professions such as refrigeration by having access to training and mentoring and an overview of obstacles and solutions encountered by women in their professional career.
Another perspective would be to consider undergraduate studies. In fact, AiCARR can play a significant role by promoting inclusion initiatives that would attract girls and might even impact their choices of university career and as a consequence increase the number of women in engineering fields. Many other useful synergies can be implemented such as signing of agreements with professional women associations dedicated to women's empowerment and to increasing female presence in engineering and architecture.

- Norway: Dutch association of companies in the field of Refrigeration and Air Handling (NKF)

In Norway, the way to attract young people into the refrigeration sectors is mainly via active information campaign at different educational levels. At high school level, there are examples where companies every year are visiting schools to inform the pupils about the job possibilities within the refrigeration sector. The aim is to encourage them to join the dedicated refrigeration specialization classes. The participants of these programs are then starting their educational training with partner companies within the refrigeration sector to become a refrigeration expert within two/three years.
At university level, the students of the master program participating in the refrigeration related course are encouraged to become member of the Norwegian Society of Refrigeration. The membership is free of charge for students and has a moderate rate for young members. The master students are also actively participating in the annual refrigeration event of the Refrigeration Society by presenting their ongoing work of the master thesis.
It was highlighted that there are no incentives to attract women/girls into the refrigeration sector maybe because in the board of NKF has only male participants, which is unusual in many other organisations.

3.2.2. North America

- USA: American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

Diversity is one of ASHRAE's Core Values. Young professionals and women serve in many positions of leadership throughout all levels of the organization, including on Society's Board of Directors, Councils, and Committees, as well as on Regional Bodies and Chapter Boards of Governors and Committees. More specifically, ASHRAE supports the inclusion of young people and women into RACHP through a wide variety of programs and activities, such as:

- Multiple scholarships, including ones that target certain demographic groups;
- Special student membership rates that are significantly lower than full dues;
- Student Activities Committee at the Society and local Chapter levels, including subcommittees on K-12 and post-high-school;
- Young Engineers in ASHRAE (YEA) Committee at the Society and local Chapter levels;

- Leadership Programs: YEA Leadership Weekends (for US/Canada and for outside the US/Canada); Leadership U Program (to "shadow" a Society Vice President at an ASHRAE Conference); LeaDRS Program (to "shadow" a Regional Officer at an ASHRAE Conference); Chapter Leadership Academy;
- Diversity in ASHRAE subcommittee of Society's Membership Promotion Committee;
- Women in ASHRAE Breakfast at ASHRAE's Winter Conference;
- Women in ASHRAE Happy Hour at ASHRAE's Annual Conference.

3.2.3. Asia

➢ India: Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE)

Various activities define ISHRAE. It reaches out to all its members and seeks their active involvement and cooperation in all the events and programs organized by the society. Women are a cornerstone of the society. As such a group on Women in the HVAC & R industry was launched during ACREX India 2017, under the leadership of Mr Vishal Kapur. This group is formed by very young and dynamic enthusiastic professionals of ISHRAE. Their aims are:

- To encourage Women to join the field of HVAC & R;
- To encourage recruitment and retention of women in the industry;
- To provide a platform for professional development, overcoming environmental and social limitations;
- To bring together professionals and share their experiences and knowledge and support each other to grow in this industry;
- To guide women in successfully getting senior roles.

To reach these goals, women in the ISRAE organize programs/activities focusing on:

- Subjects on HVAC & R (Heating, Ventilation, and Air Conditioning and Refrigeration);
- Green Building and Environment;
- Industrial Visits;
- Personal Development;
- Safety, Social Challenges and Development;
- Non-Technical (Job Oriented) training.

Compared to last year, the current one (2019-2020) is witnessing a dramatic increase in women's activities from ISHRAE. The number of programs has increased from 65 to 112. These programs welcome women speakers from various fraternities and roles such as Design Consultants, Professors, Entrepreneurs, and so on. There is also some significant increase in women representatives and active chapters from 4 to 65 and 34 to 112 respectively.

3.2.4. Oceania

➢ Australia: Australian Institute of Refrigeration, Air conditioning and Heating (AIRAH)

The AIRAH supports the progression of young people and women/girls into the refrigeration sector by offering a range of scholarships and awards to encourage the taking up of studies in the RACHP field and to recognize their contributions as their careers progress.

AIRAH offers free student membership which gives student access to a variety of educational materials and access to our extensive range of conferences and forums across Australia. AIRAH offers a mentor program for young professionals entering the industry, which is facilitated by a range of experienced members who encourage growth of individuals via sharing of their knowledge and experience. In 2016 the Women of AIRAH group was set up in as part of a national committee which develops and drive initiatives to improve the entry and subsequent engagement and retention of women in the RACHP industry in Australia. The Committee aims to:

- Increase the number of female members in AIRAH to 30%;
- Increase female participation in the AIRAH committees to 30% at all levels;
- Promote industry leadership in the following key areas: Attracting female graduates and apprentices into RACHP; Providing networking and support opportunities for women during all stages of their careers; Encouraging employers to create a diverse workplace through recruitment, career development and cultural transformations; Assisting women to feel engaged in our industry and part of the RACHP community; Improving retention of women in the RACHP industry; Highlighting the female role models within the industry and celebrating their achievements and contributions;

- Communicate the business case for diversity within the AIRAH and wider RACHP community;
- Provide guidance to the RACHP industry to develop a considered and integrated approach to gender diversity.

3.2.5. Africa

- South Africa: South African Institute of Refrigeration and Air Conditioning (SAIRAC)

SAIRAC supports the career development of any individual with training courses or technical talks where valuable industry experience is shared. This is equally open to non-members wanting to gain some skills and hopefully make themselves more attractive for employment or serving the RACHP sector in some way. SAIRAC support students that qualify for the world trades competition. The most recent event was held in Russia.

SAIRAC do have a student membership, although their percentage has always been minor. Membership it is not free, but it remains at a very insignificant price for students. There are some educational/schools fairs that are attended by SAIRAC, the next fair will take place in January and February 2020 in a few South African cities. SAIRAC needs part-time committee members to host the shows but time and finance do not always allow it.

4. DISCUSSION

The IIR Careers in Refrigeration (CaRe) working group initial objectives set in the first IIR workshop (Colombo et al., 2015) have been almost reached:

- Mentoring and networking: CaRe organised a speed networking event for students and young researchers during the IIR International Congress of Refrigeration in 2019 in Montréal, Canada. A similar event was held at Chilventa exhibition in 2018 in Nuremberg, Germany with the support from European Partnership for Energy and the Environment (EPEE).
- Having more women represented in the IIR statutory organism: At the IIR statutory meetings in the ICR2019, Professor Judith Evans has been elected as new Vice-President and Head of Section C (Biology and Food technology) and a new member of the IIR Management Committee. Also, Silvia Minetto has been elected as new president of the IIR Commission D2 on refrigerated transport. In 2015, women represent 10% of the IIR commission members (41 women to 369 men): These figures need to review and compared.
- Increase visibility by promoting refrigeration to the younger generation: The IIR is part of the Management Committee of the Exposition on Refrigeration that took place at the La Cité des Sciences et de l'Industrie (in Paris, France) from December 2017 to September 2018. This first exposition main objective was to promote refrigeration to children from primary and secondary schools and was a success with 280,000 visitors. This exposition has now moved to South Korea.

The CaRe additional objectives until the next IIR International Congress of Refrigeration in 2023 (ICR2023) in Paris (France) in August 2023 are the following:

4.1. IIR Training Directory

The IIR is very committed to promoting knowledge of the refrigeration knowledge on a global level. In addition to the IIR conferences and publications, the IIR have thus developed two directories: the first brings together more than 400 experts in all refrigeration applications, and all over the world. The second lists around 200 laboratories working in our field. Today, the IIR would like to develop a third directory to promote refrigeration to young people around the world: a training directory. Indeed, with the growing development of air conditioning and current climate challenges, cold is a sector of the future, but often poorly understood by high school students or students. Providing a global directory of the various training courses offered after the baccalaureate (A-Level), and according to the different levels of study (HND/HNC, BTS, Master license etc…) would make it possible to centralize information for young people wishing to become involved in our sector. The IIR has already identified nearly a hundred organizations offering training in the cold in France and England. However, the IIR does not have the human resources necessary to draw up a directory which would identify training organizations worldwide. The IIR therefore needs the support of delegates from all our member countries to draw up and add to this directory.

4.2. Awards for IIR women

The CaRe working group would like a Special Award for outstanding scientific achievements by a woman in academic or industrial research, innovation or development, in all fields of refrigeration. This award would promote creativity and revitalisation in the fields of competence of the IIR such as the IIR Gustav Lorentzen and Science and Technology Medal which would be given during the IIR Congress.
Also, to reward the partner/companion of a person with outstanding achievements in the promotion of the IIR who also may serve as a role model for the younger generations, such as the IIR Honours given during the IIR Congress. As we know behind a great man there is a great woman!

5. CONCLUSIONS

This paper provides an update of the IIR preliminary state-of-the-art of women representation in the refrigeration field collected from national RACHP institutions and associations. It highlights new national, regional and international incentives to promote refrigeration to the younger generation and women in particular. The percentage of women registered in the national associations/institutions has increased significantly over the last 5 years in the following countries: UK (IOR), Norway (NKF), USA (ASHRAE), Australia (AIRAH), India (ISHRAE) and South Africa (SAIRAC). The majority of these countries have effectively doubled their female membership by establishing specific steering groups to engage and attract more women to this industry. Several initiatives are undertaken by these national association groups, these include social media campaigns, mentoring, networking, outreach to schools, awards and scholarships. Also, there has been an increase in role models i.e. professionally successful women on leadership positions in the industry and associations, featured on trade press promoting diversity and inclusion in the industry.
In order to further promote careers in refrigeration to the new generation and increase women representation in the industry the IIR CaRe group will develop a training directory in refrigeration, introduce a new award for outstanding scientific work and engage national steering groups to extend their reach internationally.

ACKNOWLEDGEMENTS

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The support from the GreenSCIES - Green Smart Community Integrated Energy Systems project is gratefully acknowledged.

NOMENCLATURE

RACHP	Heating, Ventilation, Air Conditioning and Refrigeration	JSRAE	Japan Society of Refrigerating and Air Conditioning Engineers
GHG	Greenhouse Gas	IRHACE	Institute of Refrigeration, Heating & Air Conditioning Engineers of New Zealand
GtCO2eq	Giga tonne CO2 equivalent	JNC	Jordan Engineers Association
RQF	Regulated Qualifications Framework	NKF	Dutch association of companies in the field of Refrigeration and Air Handling
RNCP	Répertoire National des Certifications Professionnelles	AGFR	Refrigeration Technician General Association in Romania
AIRAH	Australian Institution of Refrigeration, Air Conditioning and Heating	ABOK	Russian Association of Engineers for Heating, Ventilation, Air Conditioning, Heat Supply and Building Thermal Physics

ABRAVA	Brazilian Association of Refrigeration, Air Conditioning Ventilation and Heating	SAREK	Society of Air Conditioning and Refrigerating Engineers of Korea
APFC	Association of Professionals and Actors of Refrigeration and Air Conditioning of Burkina Faso	SAIRAC	South African Institute of Refrigeration and Air Conditioning
HRAI	The Heating, Refrigeration, Air Conditioning Institute of Canada	IOR	Institute of Refrigeration UK
CAR	Chinese Association of Refrigeration	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ACOPROF	Congolese Association of Refrigeration Technicians and Air Conditioning	WiRACHP	Women in Refrigeration Air Conditioning Heat Pump
AFF	French Association of Refrigeration	WiBSE	Women in Building Services Engineering
DKV	German Refrigeration and Air Conditioning Association	WES	Women's Engineering Society
ISHRAE	Indian Society of Heating, Refrigerating and Air Conditioning Engineers	YEA	Young Engineers in ASHRAE
AiCARR	Italian Association for Air Conditioning, Heating,	RACHP	Refrigeration, Air-Conditioning and Heat Pumps

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