

Safety, Upskilling, and Good Servicing Practices for Cooling

Standardising Training for Refrigeration and Air-conditioning Technicians

Apurupa Gorthi, Shikha Bhasin, and Vaibhav Chaturvedi

Issue Brief | July 2020





Currently low, the residential air conditioning demand is expected to see an eleven-fold growth in India in the next decades.

Source: Ozone Cell 2019

Image: Emotivelens



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The Council on Energy, Environment and Water (CEEW) is one of South Asia's leading not-for-profit policy research institutions. **The Council uses data, integrated analysis, and strategic outreach to explain – and change – the use, reuse, and misuse of resources.** The Council addresses pressing global challenges through an integrated and internationally focused approach. It prides itself on the independence of its high-quality research; develops partnerships with public and private institutions; and engages with the wider public.

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“Right from the Montreal Protocol to the recently released India Cooling Action Plan, the refrigeration and air conditioning (RAC) servicing sector training has been hailed as a priority both from a climate and skill development perspective. While these provide goals and outcomes, through this issue brief we attempt to lay the path towards a well-rounded training infrastructure. We aim to create a training infrastructure that equips servicing sector professionals with pro-environmental sensibilities, career development opportunities and excellent skills.”



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Shikha Bhasin is a researcher on climate change mitigation policies, keenly interested in low-carbon technology innovation systems. She leads The Council's research on cooling and phasing down hydrofluorocarbons (HFCs). A co-author of the *India Cooling Action Plan (ICAP)*, she continues to serve on ICAP implementation committees in R&D and the service sector.

“RAC servicing technicians are the face of this booming industry. Their safety and knowledge are directly related to households' wellbeing and environmental preservation related to AC usage.”



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Vaibhav Chaturvedi, a Research Fellow at CEEW, leads The Council's 'Low-Carbon Pathways' research. His research focuses on Indian and global climate change mitigation policy issues through the integrated assessment modelling framework of the Global Change Assessment Model (GCAM). Vaibhav has a doctorate in economics from the Indian Institute of Management Ahmedabad and a master's degree in forest management from the Indian Institute of Forest Management, Bhopal.

“Quality training is a critical intervention needed to enhance the quality of human capital engaged in the air-conditioning servicing sector in India. With the servicing sector being a key focus of the India Cooling Action Plan (ICAP), standardisation of training is a must. The CEEW analysis, based on intensive stakeholder discussions, intends to understand and change the existing landscape of AC servicing technician training in India, to achieve the developmental and environmental goals of the ICAP.”



Image: iStock

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Acronyms

| | |
|---------|--|
| AC | air conditioning |
| CTS | <i>Craftsman Training Scheme</i> |
| DGT | Directorate General of Training |
| DVET | Directorate of Vocational Education and Training |
| ESI | Employees State Insurance |
| ESSCI | Electronics Sector Skills Council of India |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| GSP | good servicing practices |
| HC | hydrocarbon |
| HCFC | hydrochlorofluorocarbon |
| HFC | hydrofluorocarbon |
| HFO | hydro fluoro olefin |
| HPMP II | <i>Hydrochlorofluorocarbon Phase-out Management Programme Stage II</i> |
| ICAP | <i>India Cooling Action Plan</i> |
| ISHRAE | Indian Society for Heating, Refrigerating and Air-conditioning Engineers |
| ITI | Industrial Training Institute |
| MoEF&CC | Ministry of Environment, Forests and Climate Change |
| MSDE | Ministry of Skill Development and Entrepreneurship |
| MSME | Ministry of Micro, Small and Medium Enterprises |
| NOS | National Occupational Standards |
| NSDC | National Skill Development Council |
| NSQF | National Skills Qualification Framework |
| ODS | ozone depleting substance |
| OEM | original equipment manufacturer |
| PPE | personal protective equipment |
| QP | qualification pack |
| RAC | refrigeration and air-conditioning |
| RPL | recognition of prior learning |
| SC | scheduled caste |
| SSC | Sector Skill Council |
| ST | scheduled tribe |



About 40% of India's HCFC use is attributed to the RAC Servicing sector.

Source: Ozone Cell (2017)

Image: iStock

Overview

The *India Cooling Action Plan (ICAP)* is a first-of-a-kind comprehensive policy roadmap drafted by the Ministry of Environment, Forests, and Climate Change (MoEF&CC) aiming to provide sustainable cooling in India. Among various cooling sectors, the ICAP places priority on the development of the refrigeration and air-conditioning (RAC) servicing sector (hereafter servicing sector). More specifically, standardisation of training and a skill certification were identified as two immediate steps to be taken for developing the servicing sector. In this brief with a focus on India's servicing sector training landscape, we explore how training curricula could be standardised by adopting a common code, the National Occupational Standards (NOS).

The widespread use of cooling equipment and their increasing penetration in India can proportionately

drive up the demand for servicing technicians. Further, in keeping with India's commitment to the Montreal Protocol's Kigali Amendment, training programmes need to be upgraded to incorporate safe and good handling of both current refrigerant gases and alternative refrigerants, as well as, associated component changes. The training programmes designed for servicing technicians should enable the acquisition of necessary skills by both new entrants and experienced technicians. In this context, we explore employing NOSs to standardise training curricula designed for servicing sector technicians having different levels of work experience and skill outcome needs.

Based on a literature review of India's skill developmental priorities and the HFC phase-down as per the Kigali Amendment, coupled with our own understanding of the state of the sector, we propose four priority areas for framing NOSs for training programmes in this issue brief.

Priority areas for training

1. Good Servicing Practices (GSP) to limit refrigerant wastage and maintain energy efficiency of the air conditioning (AC) equipment



2. Knowledge and practical skills for handling alternative refrigerants



3. Practicing occupational safety



4. Employability skills and career development



We chose five government training programmes designed for various skill outcomes and experience levels of service technicians to check if the four priority areas that we have identified were included in their curricula. We selected government programmes because these are required to adopt NOSs, if they have not already done so. We noted that each of the four priority areas were touched upon to some extent across the government training curricula. But their lack of alignment calls for taking remedial measures. Aligning all curricula to include both the term GSP and standardising the specific steps may be

imperative for its widespread adoption. Training on alternative refrigerants was typically limited to their environmental impact. Workplace (occupational) safety was the only priority area covered in depth and featuring similar content across all five training curricula. Employability skills and career development was commonly limited to digital literacy and interpersonal communication with few curricula including information on social security benefits like medical insurance, accident insurance, labour rights etc.

1. Based on in-person communication with representatives from the Electronics Sector Skill Council of India (ESSCI) on 31st January 2020.

The priority areas highlighted in this brief can help achieve a minimum level of standardisation. Further, standardisation through the NOS framework calls for alignment of the curricula without obliterating the variety of training programmes currently in existence. Moreover, curricula thus standardised can help create a training landscape that is equitable, safe, environmentally sound, as well as one which offers career development opportunities to servicing sector professionals.

1. Introduction

A global timeline for hydrofluorocarbon (HFC) phase-down was set by the Kigali Amendment to the Montreal Protocol. The Amendment followed its predecessors in accommodating for ‘common but differentiated responsibilities and respective capabilities’, thereby allowing different phase-down schedules for different countries (Press Information Bureau 2016). The extended timeline India negotiated for under the Kigali Amendment allows sufficient time to accommodate a reconfiguration of the cooling industry, thereby facilitating developmental gains

as well as mitigation of greenhouse gas emissions (Purohit et al. 2016; Chaturvedi and Sridhar 2016). Under this, the refrigeration and air-conditioning (RAC)² servicing sector (hereafter servicing sector) and its development is a priority (Ozone Cell 2019). This precedence resonates both with Montreal Protocol’s servicing sector focus and India’s vocational skill development prioritisation (Ozone Cell 2017; Prasad et al. 2016).

Under the different developmental activities³ for the servicing sector, the *India Cooling Action Plan* (ICAP) recognised the need for widespread training of servicing sector professionals as a priority (Ozone Cell 2019). The ICAP predicted a steady rise in demand for servicing technicians in the next decade due to increasing penetration of cooling equipment in homes, offices, and automobiles, among others (Ozone Cell 2019).

To cater to the rising demand, the ICAP recommended that the existing and emerging servicing sector workforce needed to be trained and provided a skill certification, in addition to providing access to social security benefits. For this, the ICAP identified



Image: EmotiveLens

2. In a previous CEEW publication, residential air-conditioning was abbreviated to RAC. However, as per the ICAP, RAC refers to refrigeration and air-conditioning sector. The ICAP definition of RAC has been used in this brief.
3. It is noteworthy to mention that the ICAP also called for a need for servicing sector formalisation (definition for formalisation is in footnote 4) as the overall development of the sector hinges on this. However, formalising the servicing sector is a long-drawn process involving several activities, one of which is availability of good quality training that suit technician skill needs. While this document attempts to address formalisation, the authors acknowledge that this is not the focus of this report.

standardisation of training as the first step towards a well-developed training landscape in India (Ozone Cell 2019).

Over the years, multiple stakeholders from both government and industry have created training programmes to address immediate RAC servicing sector skill requirements. The existence of a variety of training programmes can be attributed to a continuous need for technical skill upgradation in response to new cooling technology as well as government priorities in skilling. As a consequence, training programmes tend to differ in their skill focus. For instance, training programmes under the Montreal Protocol have a refrigerant focus, whereas private company-led training may focus on a specific technology such as inverter AC (Sridhar and Chaturvedi 2017). Further, while several training programmes have been created and many institutions have become involved in their implementation, the number of trained technicians remains small (Sridhar and Chaturvedi 2017; Executive Committee of the Multilateral Fund 2018b). Finally, due to a largely informal⁴ servicing sector, technicians may not have access to all training programmes leading to lack of uniformity in the technician skill set and practices on-field (Ozone Cell 2019).

In this context, we explore employing a common code for curricula standardisation, that is, the existing *National Occupational Standards* (NOS). These are used for vocational education to standardise training curricula. NOSs can be useful for designing training curricula of servicing sector technicians with different levels of work experience and skill outcome needs.

This brief is a first of its kind assessment of some of the most prominent government training programmes and their curricula for RAC service technicians (hereafter servicing technicians) in India. Further, we attempt to interweave standardisation into curricula upgradation of the training programmes keeping in mind the future needs and also up-skilling of India's servicing sector technicians.

The ICAP calls for “synergies amongst existing institutions/centres,” so that all the entities

Standardisation of curricula is imperative to ensure all training programmes incorporate topics that address changes anticipated for the HFC phase-down in India.

involved in imparting servicing sector training are aligned (Ozone Cell 2019). Efforts have been put into aligning the Industrial Training Institute's (ITI) servicing technician curriculum Montreal Protocol's focus on proper refrigerant handling (Agarwal 2004). No such efforts have been made between other government training programmes or between private and government training programmes. Thus, standardisation needs to address the lack of alignment in training curricula.

Another key issue in the current training landscape is how this training is accessed by the servicing sector. For example, the ITIs offer a two-year foundational training for inexperienced, aspiring servicing technicians to prepare them for opportunities in the servicing sector along with the promise of upward mobility in the sector (Prasad et al. 2016). In contrast, Montreal Protocol and industry-led training are both typically designed to be short-term refresher courses. However, few technicians receive training in the intended order, that is, a formal two-year degree in vocational education followed by regular refresher courses. The current mismatch in what each training programme offers and variable access to these training programmes remains a key challenge in the servicing sector training. Standardisation of training curricula can offer a common set of skills across all programmes.

A final frontier is the need to continually update training curricula. With the Kigali Amendment to the Montreal Protocol coming into force in India in the next decade, servicing sector's training programmes need to reflect requisite knowledge and skills on alternative refrigerants and associated component changes (Bhasin et al. 2019). Here again, standardisation of curricula is imperative to ensure all training programmes incorporate topics that address changes anticipated for the HFC phase-down in India.

4. Definition for the formal and informal sector is based on Sridhar and Chaturvedi (2017). They considered formal sector as service centres authorised by manufacturers (provide services under warranty or have access to official spare parts) and multi-brand centres which are registered enterprises (not authorised by manufacturers). They further clarify that self-employed individuals and own-account or unregistered enterprises constitute the informal sector.

This issue brief focuses on the following:

- Employ the NOS framework to identify priority areas in servicing sector training that need to be incorporated across all training curricula.
- Compare curricula of existing government training programmes in the context of the priority areas identified and in turn develop sector specific NOSs.

This research lays out priority areas for servicing sector training curricula and how they can be incorporated into the training curricula of existing government programmes.

Section 2 elucidates the different training programmes that are available in the RAC servicing sector. Section 3 makes the case for NOS as a means to bring about standardisation and proposes priority areas for this. It further elucidates how existing training curricula can be aligned under the NOS framework by comparing five government training programmes; and also suggests the formulation of NOSs that could be applicable across all training programmes. In the final section, we draw on key insights from this research and present policy recommendations.

2. India's current RAC servicing sector training landscape

The RAC servicing sector accounts for over 40 per cent of hydrochlorofluorocarbon (HCFC) use in India (Ozone Cell 2017). During every refrigerant transition, this sector assumes priority for interventions (Ozone Cell 2017). Various channels of training have been established in India for fulfilling the vocational education targets as well as the country's endeavour to meet Montreal Protocol commitments (Prasad et al. 2016; Ozone Cell 2017). These channels of training broadly fall under the following categories: central government, state government, and private sector training programmes (Ozone Cell 2019).

2.1 Three channels of training programmes

Central government training programmes

One track of training programmes by the central government are typically comprehensive, of long-duration, and vocational in nature (e.g. ITI programmes). These programmes are designed to train individuals who are interested in a career in the servicing sector. In contrast, the Ozone Cell refresher



Image: Rajesh Mallik, RASSS



Image: iStock

training programmes under the Montreal Protocol, run by the central government, typically last for a short-duration and are aimed at acquainting technicians with new refrigerants and associated technologies. Another such short-term training is the Electronics Sector Skill Council's (ESSCI) Recognition of Prior Learning (RPL) programme.

State government training programmes

Training programmes run by the state governments⁵ are based on mandates issued by the central government but executed by various other departments in the state government that may also design the curriculum. One unique feature of these programmes would be training offered in regional languages. We present an example of a state government-run programme in this brief, but information on these programmes is limited. Further, in most cases, state governments take up the role of implementing training programmes rather than designing them.

Private sector training programmes

Private sector training programmes are largely short-duration courses that are conducted by original equipment manufacturers (OEMs) and industry associations. Two types of technical training are offered by the private entities: (i) training for skill upgradation of employees (e.g. Indian Society for Heating, Refrigerating and Air-conditioning Engineers (ISHRAE) certification programme) and (ii) training on company-specific equipment for service technicians (e.g. Godrej Vocational Training).⁶ Typically, skill upgradation training is restricted to service engineers and managers employed in companies.⁷ Company-specific equipment training is often provided to service technicians, for handling a specific company's appliance. This form of training may be appropriate for troubleshooting or understanding other unique features of the equipment.⁸ However, as service technicians may be involved in servicing of appliances from different companies in their everyday work, this kind of training could be insufficient.

5. As regards ITIs, the training schemes, policy evolution, training standards, norms, assessments, and certification are determined by the central government, while the state governments are involved in their day-to-day administration. For this brief, we consider ITIs under the central government as the curriculum design is carried out at that level.

6. Based on a stakeholder roundtable consultation conducted on 17 December 2019.

7. During a focus group discussion, service technicians remarked that they despite being employed by formal sector companies may not be on their payroll. This, in turn, could restrict their access to benefits. Access to company-sponsored advanced training could also be limited for service technicians, possibly hampering progression in their career path. Workplace learning during apprenticeship or everyday interaction with supervisors is no doubt an essential mode of learning (see Green 2006). However, given the informal nature of the service sector in India, the efficacy of this type of training is largely unknown and may be limited.

8. Based on a stakeholder roundtable consultation conducted on 17 December 2019. Training for troubleshooting cannot be standardised as the controllers differ from company to company. The training is typically product and the model based.

Any plan of action developed for government training can be extended to private sector through appropriate hard or soft policy mandates.

The private sector is an important part of service sector training. In this brief though, our focus is on government training programmes as these are already required to adopt the standardisation under NOS (NSDC nd). Any plan of action developed for government training can be extended to private sector through appropriate hard or soft policy mandates.

2.2 Overview of training programmes and their curricula

We identified five government-run training programmes for our analysis. We contacted relevant stakeholders for clarificatory interviews when information available was insufficient (see Annexure 2). Table 1 collates information on these five training programmes. While this is not an exhaustive list, it provides sufficient insight into what is contained in existing training programmes.

I. Hydrochlorofluorocarbon (HCFC) Phaseout Management Programme Stage II (HPMP II) by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Name of the training manual: Good Servicing Practices and Installation of Room Air-conditioners with HCFC-22 and Flammable Refrigerants

This training programme was instituted through a bilateral partnership between Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Ozone Cell of the Ministry of Environment, Forest, and Climate Change (MoEF&CC) under the Montreal Protocol. The training manual was updated in 2018 and is used for training based on the *Hydrochlorofluorocarbon (HCFC) Phaseout Management Programme (HPMP) Stage II*.⁹

GIZ determines the number of training sessions to be held in a year. Fifteen training partners have been appointed across the country and they hold responsibility for the implementation of training. The training is provided free of cost to technicians. Practical training is an important aspect of this two-day course, and equipment is available at the site of training. This is a skill upgradation training; therefore, technicians with substantial experience can only attend it. The course does not offer a formal evaluation, instead, a certification of participation is provided upon completion of the two-day course.

II. Recognition of Prior Learning (RPL) by the Electronics Sector Skills Council of India (ESSCI)

*Name of the training manual: Field technician—Air conditioning*¹⁰

This programme was developed by the ESSCI to recognise and certify technicians who have experience in the servicing sector, hence the name, Recognition of Prior Learning (RPL).¹¹ Course enrolment is restricted to servicing technicians who have sufficient experience or a formal degree in the field (e.g. Diploma in Electrical/Mechanical/Refrigeration and Air Conditioning). Practical training is provided to the technicians for the installation and repair of split and window ACs in residences in this three-day training programme. Special emphasis is laid on soft-skills in the curriculum as the participants are taught English language literacy, digital literacy, and entrepreneurial skills.

An accident insurance worth INR 2 lakh valid for a period of three-years and Mudra Bank Loan facilities are provided to the participants along with the certification.

9. Based on a telephonic interview with Mr C. J. Mathew, an HPMP training partner and a co-author for the handbook R. S. Agarwal et al. (2018).

10. As part of the Sector Skill Council for the Electronics sector, the ESSCI offers two other training programmes for service technicians. One is called 'Field Technician: Refrigerator' and the other is 'Field Engineer: Refrigerator, Air conditioner and Washing Machine'. However, these programmes will not be discussed here due to overlapping information.

11. As part of the Sector Skill Council for the Electronics sector, the ESSCI offers two other training programmes for service technicians. One is called 'Field Technician: Refrigerator' and the other is 'Field Engineer: Refrigerator, Air conditioner and Washing Machine'. However, these programmes will not be discussed here due to overlapping information.

A formal evaluation is done by ESSCI's assessment partners. Upon successful completion of skill evaluation, a qualification certificate (with a three-year validity) is awarded to technicians. An accident insurance worth INR 2 lakh valid for a period of three-years and *Mudra Bank Loan* facilities are provided to the participants along with the certification. The training is currently provided free of cost. A stipend of INR 500 is awarded to every candidate who successfully completes the certification.

III. Craftsmen Training Scheme (CTS) by the Directorate General of Training (DGT)

Name of the training programme: Mechanic in Air-conditioning and Refrigeration

This two year course is offered to inexperienced candidates who have completed middle school (8th standard).¹² The programme is facilitated by the Directorate General of Training (DGT), Ministry of Skill Development and Entrepreneurship (MSDE).¹³ The CTS for Air-conditioning and Refrigeration is offered across over 900 government and private ITIs.

This training programme aims to impart theoretical and practical knowledge of core subjects in RAC and also to improve employability skills. In this two-year diploma, training is provided in a variety of cooling equipment, including room ACs (window, split, cassette and duct), car AC, commercial refrigeration units (water coolers/dispensers, bottle cooler, deep freezer, ice cube machine and softy machine, cold storage, walk-in cooler), and commercial AC equipment. In the last six months of the training programme, the students are sent for an industry apprenticeship. A National Trade Certificate (NTC) is awarded upon successful completion of the formal assessment.

IV. Room Air-conditioner and Home Appliance (RACHA) Engineer Training by the Ministry of Micro, Small and Medium Enterprises (MSME)

Name of the training programme: Room Air-conditioner and Home Appliance Engineer Training

This course was designed for professionals for undergoing technical training in RAC to become a 'Service Engineer'.¹⁴ The candidates who wish to enrol for this programme should have completed an ITI degree or high school or possess a diploma in mechanical engineering. The curriculum was designed by the Ministry of Micro, Small and Medium Enterprises (MSME) in close consultation with industry experts. The training costs INR 20,000 per candidate with fee waivers for certain government-mandated sections.

The training is largely practical in nature (282 hours) and an additional 208 hours of on-the-job training is mandated as a part of this course. In addition to providing training on ACs, the course also provides practical training in installation, repair, and service of other home appliances such as refrigerator, washing machine and microwave oven. The MSME Tool Room and training centres of each state in collaboration with Samsung Training School conduct this training.

V. Mechanic Refrigeration and Air-conditioner by the Directorate of Vocational Education and Training (DVET), Government of Maharashtra

*Name of the training programme: Mechanic Refrigeration and Air-conditioner*¹⁵

This training was designed for inexperienced students who have completed middle school (completed 8th standard). It is facilitated by the state government and implemented by accredited training institutions. Accreditation is obtained through periodic inspection of the training facilities. Teaching material and the training is conducted in regional languages. The training is provided free of cost.

This is a six-month course and all candidates are eligible to appear for an evaluation upon attending the six-month training. Practical experience is an important aspect of this training, imparted not only through laboratory work but through apprenticeship as well.

12. See Directorate General of Training (2018) for more information on this scheme.

13. The implementation aspects of the CTS programme have reportedly been taken over by the ESSCI. The authors did not find the relevant official press release. The information was conveyed to the authors during a stakeholder meeting with ESSCI personnel. Based on information available in: <http://www.msmetoolroomkolkata.com/split-ac-cassette-ac-room-air-conditioner-rac/>.

14. Based on information available in: <http://www.msmetoolroomkolkata.com/split-ac-cassette-ac-room-air-conditioner-rac/>.

15. The course curriculum is not available online and therefore the information is based on an interview with Mr Vikram Murthy, a training partner for this training. The course curriculum website does not provide any details on the subjects covered. However, information on the types and number of equipment to be available in every classroom is specified. Information on the equipment can be found: <https://vti.dvet.gov.in/Admin/ManageNormsNew/DisplayTradeInfo/139>.

Table 1 summarises the earlier-mentioned information.

Table 1 Features of five government training programmes aimed at training servicing sector technicians

| Name of the training programme | GIZ HPMP II ¹⁶ | ESSCI RPL ¹⁸ | DGT CTS ¹⁹ | MSME RACHA ²⁰ | DVET Mechanic Refrigeration and Air-conditioning ²¹ |
|--|--|--|---|--|---|
| Instituted by | Ozone Cell (Ministry of Environment, Forests, and Climate Change) | Ministry of Skill Development and Entrepreneurship and Ministry of Environment, Forests, and Climate Change | Ministry of Skill Development and Entrepreneurship | Ministry of Micro Small and Medium Enterprises | Government of Maharashtra (Skill Development and Entrepreneurship Department) ²² |
| Training implementors | GIZ–Ozone Cell/ Training partners ¹⁷ | ESSCI/ Training partners | Directorate General of Training/ ITI | MSME Technology Centre/ Central Tool Room & Training Centre | Department of Vocational Education and Training / Private training institutes ²³ |
| Trainee experience levels | Experienced Minimum of two years of work experience | Experienced Passed 8 th standard and a minimum of two years of work experience or ITI/ Diploma (Electrical/ Mechanical/ Refrigeration and AC) with no experience | Beginner Passed 10 th standard | Experienced ITI Diploma in Refrigeration and AC/ Mechanical Engineering | Beginner Passed 8 th standard |
| Cost of training (for the trainee) | Free of cost | Free of cost | Varies depending on the specific ITI | INR 20,000 (No fees for SC/ST candidate) | Free of cost |
| Training duration | 2 days | 3 days | 2 years | 4 months | 6 months |
| Training curriculum year published/ Last updated | 2013/2018 | 2018/ 2018 | 2014/ 2018 | Not specified | 2006/ 2016 |
| Training equipment focus | Room AC | Room AC | Room AC, car AC, various commercial and plant-scale cooling equipment | Room AC, microwave oven, washing machine | Room AC |
| Practical training? (Yes/No) | Yes | Yes | Yes | Yes | Yes |
| Training assessment? (Yes/No) | No | Yes | Yes | Yes | Yes |

Source: Authors' compilation

Note: This list is not exhaustive

16. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) *Hydrochlorofluorocarbon (HCFC) Phaseout Management Programme Stage II*.

17. Fifteen training partners have been identified by GIZ and the Ozone Cell. Each training partner has at least three qualified trainers. List of all training partners can be found here: <http://ozonecell.in/wp-content/uploads/2018/10/HPMP-Flyer.pdf>.

18. Electronics Sector Skills Council of India's *Recognition of Prior Learning*.

19. Directorate General of Training's *Craftsmen Training Scheme*.

20. Ministry of Micro, Small and Medium Enterprises' *Room Air-conditioner and Home Appliance Engineer Training*.

21. Directorate of Vocational Education and Training, Government of Maharashtra's training for *Mechanic Refrigeration and Air-conditioner*.

22. This is a state government training programme. Information for this was gathered from a telephonic interview with Mr Vikram Murthy who conducts Maharashtra state government prescribed trainings for service technicians through a private training institute.

23. The training can only be conducted by the centres accredited by the DVET. The government website specifies the 'machine norms list' providing names of tools and equipment and their quantity required for the training. Annual inspections by the DVET ensures that training centres meet the accreditation requirements. The accreditation of these institutes is renewed annually. Only candidates from accredited institutes are qualified to take up the examination conducted by the government.

3. Standardising the existing training curricula

There are an estimated 2 lakh service technicians in India’s RAC servicing sector at present, and the number is expected to grow substantially in the next two decades (Ozone Cell 2019). Standardisation is necessary to impart a common set of skills to service technicians through training programmes. In the following sections we explore how this standardisation can be achieved.

3.1 Significance of National Occupational Standards

A previous study by CEEW stressed that there is an immediate need to standardise servicing sector training (Sridhar 2017):

“Standardisation of servicing can provide both technicians and training institutes with a set of basic performance criteria to follow during

teaching and actual servicing. They can also give training institutes benchmarked curriculum pointers of topics to be covered during servicing training.”

NOSs are standards of performance, knowledge and understanding of an individual required for a job (NSDC nd). The term Qualification Packet (QP) is used while referring to a job-specific NOS.²⁴ NOS serves the dual purpose of aiding in curricula design for training and in providing assessment instruments for evaluation and certification of trainees. The National Skill Development Council (NSDC) has outlined processes to be followed in proposing NOS as summarised in Figure 1.

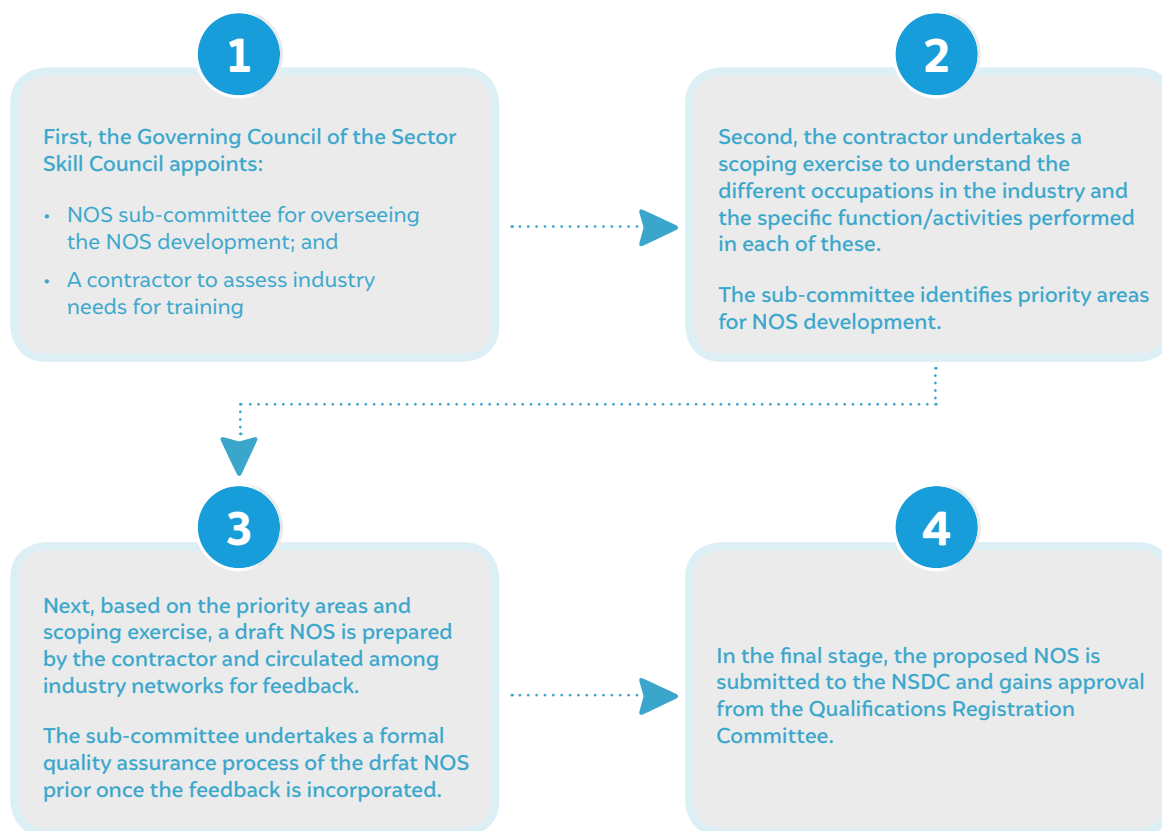
It is obvious that different job roles may need different NOSs, but within a sector, some NOSs can be common. For example, consider the following NOSs ‘Engage with customer for service’ and ‘Install AC’ functions. Such NOSs can be found in the ESSCI’s RAC training curriculum for both Servicing Engineers²⁵ and Servicing Technicians²⁶. Further, NOSs offer sufficient flexibility that the specific scope of task and knowledge of the personnel can vary depending



24. For the purposes of this brief we focus on NOS development and do not delve into job specific QPs.

25. The curriculum for this programme can be found in the following link: https://nsdcindia.org/sites/default/files/MC_Rev_ELEQ3105_Field%20Engineer_RACW_16.07.2018.pdf.

26. The curriculum for this programme can be found in the following link: https://nsdcindia.org/sites/default/files/MC_Rev_ELEQ3105_Field%20Engineer_RACW_16.07.2018.pdf.

Figure 1 Four steps for creating National Occupational Standards for a training programme by the Sector Skill Councils

Source: Authors' compilation based on documentation by the National Skill Development Council (NSDC nd)

on their role. For instance, for the NOS 'Install AC', among the tasks defined for the servicing engineer was 'interact and train technician', which was not included for the technician. Thus, common NOSs can be useful in ensuring similar skills are imparted across different job roles, allowing for a certain degree of standardisation in the curricula. Further, NOSs allow scope of tasks to be defined differently for job roles, thereby accommodating for different experience levels of the trainees and their skill requirements.

Once the NOS is developed, benchmarking is done by assigning a National Skills Qualification Framework (NSQF) level (NSDC nd). The NSQF levels are assigned by the Sector Skill Councils (SSC) using specific subjective indicators and how the NOS aligns with those indicators (NSDC nd). Assignment of NSQF levels is based on how closely the learning outcome

of the training aligns with the level descriptors (NSDC nd). The training curricula for RAC servicing sectors typically fall under NSQF levels 4 and 5, meaning in-depth knowledge and job autonomy are required to be displayed by the technician upon completing the training. This is a qualitative exercise that is specific to job roles for which the curricula is designed and is beyond the scope of this brief.

Table 2 specifies the NSQF levels and availability of NOSs for the training programmes described in Section 2.2. As seen in the table, NSQF levels can be assigned without the creation of NOSs. Thus, NSQF benchmarks the programmes, but curricula standardisation cannot be achieved without employing NOS. There are also some programmes that have neither an NOS nor benchmarked with an NSQF level. Further, a standardisation of training by

creating NOS does not serve any purpose if the focus of training remains different for various training programmes. In servicing sector at present, a standard set of skills need to be delivered across all training programmes. This approach will ensure that every technician who receives any kind of training has a common set of skills that are imperative for the sector.

Table 2 NOSs and NSQF levels of servicing sector training programmes

| Name of the training programme | NOS developed? | NSQF level |
|--|----------------|--------------|
| GIZ HPMP II | No | Not assigned |
| ESSCI RPL | Yes | 4 |
| DGT CTS | No | 5 |
| MSME RACHA | No | 5 |
| DVET Mechanic Refrigeration and Air-conditioning | No | Not assigned |

Source: Authors' compilation

3.2 Proposed priority areas for training

A critical step in developing NOS is the identification of priority areas. We propose, in the following section, priority areas in accordance with India's mandate for refrigerant transition and the need to up-skill technicians in the servicing sector. A value proposition for using these priority areas in curricula development and standardisation is elucidated in figure 2.

Awareness and compliance of Good Servicing Practices (GSP)

The annual leak rate of refrigerant gas in a residential AC can range anywhere between 5 and 15 per cent (Chaturvedi et al. 2015). Refrigerant leakage in AC units can be attributed to improper installation or servicing practices (Sridhar and Chaturvedi 2017). Thus, since the very beginning, the Montreal Protocol training programme has focused on limiting refrigerant gas emissions under the ambit of Good

Servicing Practices (GSP) (Agarwal et al. 2005). The Executive Committee of the Multilateral Fund of the Montreal Protocol (2018b) further stated:

“It is foreseen that, for the HFC phase-down, formal training on energy efficiency, including methods for its improvement, its relation with good maintenance practices, and methods and tools for measurement, will be required.”

GSPs are a set of standard practices to be followed during refrigerant handling to lower refrigerant wastage, minimise environmental impact, and maintain energy efficiency of the AC.²⁷ Training had a clear impact on adherence to GSP, according to Sridhar and Chaturvedi (2017), and therefore GSPs need to be made an integral part of all future training curricula.

Knowledge and practical skills in handling alternative refrigerant gases

Refrigerant transitions result in the influx of new refrigerants into the market which may require the technician to possess specialised skills for handling. Under the HFC phase-down programme, several synthetic blends and natural refrigerant alternatives are expected to replace the existing varieties of HFC (Bhasin et al. 2019). These alternatives may be flammable or toxic, necessitating a thorough knowledge of safe handling during installation, servicing, or repair of the cooling equipment. Bhasin et al. (2019) also discussed identification of different refrigerants as the bare minimum skill for the RAC technicians. Thus, training curricula need to incorporate knowledge on and skills for handling alternative refrigerants.

Implementation of measures to ensure occupational safety

Sridhar and Chaturvedi (2017) stated the need to include occupational safety in the training curricula of programmes that are aimed at service technicians. Safe refrigerant handling, especially when the industry is tending towards flammable and/or toxic refrigerants, requires an understanding of workplace safety. Given that a large part of service technician's day-to-day work is on the field, their workplace safety will extend beyond the physical infrastructure of their

27. See Annexure 2 for the latest list of GSPs as per Agarwal et al. (2018).

employers. The ICAP further states (Ozone Cell 2019):

“Most training sessions do discuss occupational safety, but how much of this is practiced by service technicians is uncertain...”

The ICAP finds occupational safety awareness as a means to encourage technicians to invest in their education and training as well as on tools and equipment (Ozone Cell 2019).

Employability skills and career development of servicing sector technicians

Efforts to ensure technician well-being through opportunities in the formal sector, must provide skills for career progress as well as access to social security benefits. The ICAP recognises technician access to social security benefits as essential. Awareness towards types of insurance available has been identified as one of the many benefits that technicians must receive and at the minimum be aware of (Ozone Cell 2019). The DGT, in addition, has promoted the

need for imparting soft skills in vocational education (Ozone Cell 2019; Mallick 2019). These measures by the DGT are aimed at overall development of the technician skill set and are typically transferrable skills, unlike technical skills, which may be suitable for a specific job alone. For instance, information on labour laws can be useful for technicians irrespective of their sector expertise. Such knowledge could encourage technicians to take up opportunities in formal sector enterprises. Further, digital literacy and interpersonal communication are soft-skills that could aid in the progression of technicians in their career path. In essence, technician knowledge on these areas can transform jobs in the AC servicing sector from a seasonal occupation to a career track for many.

Each of these priority areas for curricula standardisation are essential for the overall development of the servicing sector as highlighted through the five-point value proposition in Figure 2.

Figure 2 Five-point value proposition from standardisation of servicing sector training programmes



3.3 Comparing training curricula based on priority areas

The NOS offers an opportunity to identify essential components of practical skills and knowledge required across all training curricula. So, we have identified four priority areas for curricula standardisation: GSPs, alternative refrigerants, workplace safety, and employability skills. Taking into account these priority areas, we compared the curricula of five government training programmes in the Tables 3 through 6. The tables list topics in the existing curricula of these five programmes that fall under each of the four priority areas. We further suggest additional topics that need to be included so that these curricula are in alignment with each other and the priority areas.

Good Servicing Practices (GSP)

GSPs are essential steps in refrigerant handling and AC servicing/repair that must be followed to minimise environmental impact of the AC and also to maintain their energy efficiency. Montreal Protocol stipulated phasing out Ozone Depleting Substances (ODS) based refrigerants, and therefore the training curriculum for HPMP II laid a special emphasis on GSPs to handle the existing ODS-based equipment. As a part of the HPMP II training, GSPs have been bifurcated into those required for proper handling of refrigerants and those that can enhance the AC's energy efficiency (Agarwal et al. 2018). This is different from previous training material under HPMP that largely focused on the reduction of emission through GSPs (see Devotta et al. 2013).

The curriculum for *Craftsman Training Scheme* (CTS) offered by the ITIs under the DGT was updated under HPMP II to include GSPs (Directorate General of Training 2018). This close cooperation between the DGT and Montreal Protocol implementors can be traced back to an early training programme implemented between 1998 and 2004 (Agarwal 2004). Since then the CTS has been regularly updated as per revisions related to new refrigerant handling, safety, leak testing, evacuation and charging, GSPs, and retrofitting of drop-in refrigerants (Agarwal 2004).

A similar inclusion of GSPs is not evident in other government training curricula (Table 3). While GSPs are not part of all training programmes, best practices are taught to technicians in all these courses that we included in our analysis. The ESSCI curriculum, for instance, specifies steps for 'wet servicing', which are similar to the GSPs prescribed for energy efficiency gains as per the HPMP II. The Government of Maharashtra implemented best practices in its curriculum in handling refrigerants, which in turn could fall under GSPs.²⁸ However, it is important that across curricula, the term GSP is used while teaching the specific steps entailed and these are common.

Table 3 Comparison of the specific topics covered under Good Servicing Practices (GSP) in the five government training curricula

| Name of the training programme | Topics under Good Servicing Practices (GSP) |
|--|--|
| GIZ HPMP II | <ul style="list-style-type: none"> GSPs for room ACs. GSPs for energy-efficient operation of room AC. |
| ESSCI RPL | <ul style="list-style-type: none"> Steps in servicing for energy-efficient operation of room AC. <p><i>These fall under GSPs for energy efficiency, but the term GSP has not been used.</i></p> |
| DGT CTS | <ul style="list-style-type: none"> GSP for refrigerator system, room AC, and car AC system. |
| MSME RACHA | None |
| DVET Mechanic Refrigeration and Air-conditioning | <ul style="list-style-type: none"> Best practices in handling refrigerants. <p><i>These do not use the term GSP.</i></p> |

Source: Authors' analysis

Alternative refrigerants

Two aspects need to be integrated in training programmes with regard to alternative refrigerants: (i) awareness on the different refrigerant alternatives; and (ii) handling alternative refrigerants. The specific topics related to refrigerant gases dealt in each of the training programmes are mentioned in Table 4.

28. Based on personal communication with Mr Vikram Murthy (Tropical Air-conditioning and Refrigeration Institute Trust). Transcript available upon request.

A general awareness of ODS alternatives is a part of all training curricula. This typically includes information on the significance of the Montreal Protocol, Ozone Depletion and Global Warming. Surprisingly, environmental impacts of refrigerant gases is not a part of the DVET (Maharashtra State Government) curriculum, but concepts such as global warming and ozone depletion are taught to the students to generate awareness on these issues.²⁹ The ESSCI training includes awareness of the different refrigerant alternatives as well as their environmental impact. Based on communication with servicing sector stakeholders, we learned that the ESSCI RPL training as well as HPMP II provide practical training in repairing equipment containing Hydrocarbon (HC) 290. Further, the HPMP II curriculum includes

training on the installation and repair procedures for residential AC equipment with HCFC 22. While the MSME training does not include HC 290, safe gas charging of HC 600a a widely used refrigerant for residential refrigerators is taught.

The CTS curriculum specifies practical training on identifying various refrigerant gases (HCFC 22, ammonia, HC 290, HFC 32, HFC 410a, HFC 404a, HFC 134a, HFC 407c, and Hydro Fluoro Olefin (HFO)) based on their idle pressures. It further includes training on colour codes for different types of refrigerant cylinders (see pp. 37–38, Directorate General of Training 2018). However, the CTS curriculum is designed for a duration of two years, much longer than a training preferred by experienced technicians.

Table 4 Comparison of the specific topics covered under Good Servicing Practices (GSP) in the five government training curricula

| Name of the training programme | Topics covered under alternative refrigerant gases |
|--|---|
| GIZ HPMP II | Alternative refrigerants to HCFC 22 (focus on HC 290): <ul style="list-style-type: none"> • Need for alternative refrigerants and description of categories (natural, HFC, HFO). • Characteristics of commercialised alternative refrigerants for room AC. • Refrigeration oil and properties. • Charge quantity limits for HC 290. |
| ESSCI RPL | <ul style="list-style-type: none"> • Global warming potential (GWP) and ozone-depleting potential (ODP) of different refrigerants. • Types of refrigerant gases (CFC, HCFC, HFC, and HC). |
| DGT CTS | <ul style="list-style-type: none"> • Identify and explain different colour codes of different types refrigerant cylinders like HFC 32, HC 290, and HFO. • Classification of refrigerants, nomenclature of refrigerants including chemical name and formulae of HFCs and HFOs. • Measure pressure and temperature of ammonia (toxic), HC 290, HFC 32, HFC 134a, HFC 404a, HFC 407c, and HFOs. • Identify flammability and toxicity of A3 and A2L refrigerants. |
| MSME RACHA | <ul style="list-style-type: none"> • HC 600a safe gas charging process for a refrigerator. |
| DVET Mechanic Refrigeration and Air-conditioning | <ul style="list-style-type: none"> • Global warming and ozone depletion in the environment. |

Source: Authors' compilation

29. Based on personal communication with Mr Vikram Murthy (Tropical Air-conditioning and Refrigeration Institute Trust). Transcript available upon request.

Workplace safety

Occupational hazards and safety are topics that find mention in the first chapters of every training programme. Table 5 summarises the specific aspects of safety taught in every training programme. Concepts on safety are included in all training curricula along with some form of practical training on safety. There is not only a dedicated chapter or section on safety but also technical safety measures to be taken while performing certain tasks. For instance, HPMP II, ESSCI RPL, and DGT CTS curricula provide

safety instructions for installation, servicing, and during brazing. Safety during refrigerant handling operations such as recovery have been included as a part of HPMP II and CTS curricula.

Although safety is included across all training curricula, the need for accidental insurance is not included in any of them. Insurance may not form part of preventive measures, but it is imperative for service technicians who are continually exposed to hazardous workplace conditions to have a knowledge about accident insurance.

Table 5 Comparison of the specific topics covered under workplace safety in the six government training curricula

| Name of the training programme | Topics covered under workplace safety |
|--|---|
| GIZ HPMP II | <ul style="list-style-type: none"> • Personal safety and personal protective equipment (PPE) • Electrical safety • Fire safety • Safety while using tools and equipment • Safe handling and storage of refrigerants • Guidelines for safety while following GSPs and handling flammable refrigerants • Safe venting of HC 290 • General safety for installation • Safety precaution for brazing • First aid |
| ESSCI RPL | <ul style="list-style-type: none"> • Personal safety and PPE • Safety while using tools • Electrical safety • Safety for installation • Safety while servicing • First aid |
| DGT CTS | <ul style="list-style-type: none"> • Personal safety using PPE • Occupational safety and hazard identification • Electrical safety • Safety precautions for brazing, welding, and soldering • Safety for installation • Safe handling of refrigerant cylinders and flammable refrigerants • Firefighting • First aid |
| MSME RACHA | <ul style="list-style-type: none"> • Personal safety using PPE • Electronics safety • General safety guidelines • Safety precautions during technical repair • Fire and fire accidents • First aid |
| DVET Mechanic Refrigeration and Air-conditioning | <ul style="list-style-type: none"> • Safety (information on specific topics covered is not available) |

Source: Authors' compilation

Employability skills and career development

A variety of employability skills or soft skills are being taught across training programmes to enhance the employability of service technicians. The larger objective of including soft skills in training is to create and advance careers for technicians in the RAC servicing sector. Therefore, all training programmes provide guidelines on best practices while interacting with customers. Skills such as digital literacy, interpersonal communication, and entrepreneurship are included in some of the curricula (see Table 6).

In addition to the aforementioned soft skills, the CTS provides information on labour welfare policies. These include benefits guaranteed under various acts

such as *Factories Act*, *Apprenticeship Act*, *Employees State Insurance (ESI) Act*, payment wages, provident fund, among other topics. Given the informal nature of the servicing sector, this information could prove useful to many aspiring technicians. While the skills themselves are essential for personal development, greater awareness on other aspects of the job may motivate technicians to take up skill development in their chosen track. Finally, inclusion of governmental policies on maternity benefits and workplace misconduct in the training curricula can be beneficial not only to raise awareness but also to facilitate the entry of women into this sector. While at this point, topics on labour welfare are included only in the CTS curriculum, these need to be included in all other training curricula for servicing sector development.

Table 6 Comparison of the specific topics covered under employability skills and career development in the six government training curricula

| Training name | Employability skills and career development |
|--|--|
| GIZ HPMP II | <ul style="list-style-type: none"> • Interpersonal communication • Reading and writing skills • Professionalism (punctuality, follow-up, and knowledge and skill upgradation) • Personal hygiene |
| ESSCI RPL | <ul style="list-style-type: none"> • Interpersonal communication • Reading and writing skills • Understanding organisational policy and standards • Relative and critical thinking • Personal grooming • Personal strength and value system • Digital literacy: a recap • Money matters • Preparing for employment and self-employment • Understanding entrepreneurship • Preparing to be an entrepreneur |
| DGT CTS | <ul style="list-style-type: none"> • English literacy • Digital literacy • Communication skills • Entrepreneurial skills • Productivity • Labour welfare legislation • Quality tools |
| MSME RACHA | <ul style="list-style-type: none"> • Customer interaction |
| DVET Mechanic Refrigeration and Air-conditioning | <ul style="list-style-type: none"> • Customer interaction • Career development |

Source: Authors' compilation

Based on the comparative analysis of the existing training programmes, we propose the following topics to be considered in the next update of the training curricula (Table 7).

Table 7 Assessment of current servicing sector training curricula and topics that can be added to the next update of training curricula for the four priority areas

| Training name | Good Servicing Practices (GSP) | Alternative refrigerant gases | Workplace safety | Employability skills and career development |
|--|--|---|--------------------------|--|
| GIZ HPMP II | Satisfactory Can consider adding motivation training for implementing GSPs. | <ul style="list-style-type: none"> Identify and explain different colour codes of different types of refrigerant cylinders like HFC 32, HC 290, and HFO. Measure pressure and temperature of HC 290 and HFC 32. Safe gas charging of HFC 32. Safe venting of HC 290. | Satisfactory | <ul style="list-style-type: none"> Labour welfare legislation |
| ESSCI RPL | <ul style="list-style-type: none"> Incorporating the term 'GSP'. GSP for refrigerant handling. | <ul style="list-style-type: none"> Identify and explain different colour codes of different types of refrigerant cylinders like HFC 32, HC 290, and HFO. Measure pressure and temperature of HC 290 and HFC 32. Safe venting and safe gas charging of HC 290. Safe gas charging of HFC 32. | Satisfactory | <ul style="list-style-type: none"> Labour welfare legislation |
| DGT CTS | <ul style="list-style-type: none"> GSPs for energy-efficient operation of room ACs. | Satisfactory | Satisfactory | Satisfactory |
| MSME RACHA | <ul style="list-style-type: none"> Incorporating the term 'GSP'. GSP for refrigerant handling. GSPs for energy-efficient operation of room ACs. | <ul style="list-style-type: none"> Identify and explain different colour codes of different types of refrigerant cylinders like HFC 32, HC 290, and HFO. Measure pressure and temperature of HC 290 and HC 600a. Safe venting and safe gas charging of HC 290. Safe gas charging of HFC 32. | Satisfactory | <ul style="list-style-type: none"> Labour welfare legislation English literacy Digital literacy Communication skills |
| DVET Mechanic Refrigeration and Air-conditioning | <ul style="list-style-type: none"> Incorporating the term 'GSP'. GSP for refrigerant handling. GSPs for energy-efficient operation of room ACs. | <ul style="list-style-type: none"> Identify and explain different colour codes of different types of refrigerant cylinders like HFC 32, HC 290, and HFO. Measure pressure and temperature of HC 290 and HFC 32. Safe venting and safe gas charging of HC 290. Safe gas charging of HFC 32. | Insufficient information | <ul style="list-style-type: none"> Labour welfare legislation English literacy Digital literacy Communication skills |

Source: Authors' compilation



Image: Pramod Pungaonkar, RASSS

3.4 Proposed NOS for training curricula

Given that one of our key objectives in this brief was to identify a means to standardise training curricula, the following NOSs are being proposed, based on priority areas that we identified through a review of the current state of the sector. Further, the priority areas can be used across all training curricula for the RAC servicing sector. Guidelines have been provided in order to capture aspects of each NOS that are important across job roles. These can be defined further depending on the specific job roles they are being developed for.

NOS 1: Adherence to good servicing practices (GSP)

Guidelines:

- A list of steps should be created and included across training curricula.
- All training curricula must use the term GSP.
- Information on the significance of GSPs on environmental impact and energy efficiency gains should be included in the training.

NOS 2: Aware of and skilled in handling flammable/toxic refrigerant gases

Guidelines:

- Basic knowledge of the need for alternative refrigerants by creating an awareness on Montreal Protocol, ozone depletion, and global warming.
- Information on Kigali Amendment to the Montreal Protocol and India's HFC phase-down timeline.
- Technical knowledge and training on identification and safe handling of refrigerant alternatives.

NOS 3: Perform installation, repair, and maintenance while strictly adhering to safety protocols³⁰

Guidelines:

- Continued emphasis on personal and occupation safety in all the training curricula.
- Engaging with the industry representatives to identify additional safety training required for alternative refrigerants.
- Linking occupational hazard with the need for accidental insurance.

30. The following are closely related NOSs found in existing curricula (i.e. ESSCI's RPL Field Technician - Air conditioner): ELE/N3108 Install the air conditioner ELE/N3109 Repair dysfunctional air conditioner.

31. The following are closely related NOSs found in existing curricula (i.e. ESSCI's RPL Field Technician - Air conditioner): ELE/N3101 Engage with customer for service ELE/N0001 Interact with colleagues.

NOS 4: Employable by a formal sector enterprise*Guidelines:*

- Soft skills must include digital literacy and interpersonal communication.³¹
- Information on labour welfare policies including benefits guaranteed under various acts such as *Factories Act, Apprenticeship Act, Employees State Insurance (ESI) Act*, payment wages, provident fund, among others. These are a part of the CTS curriculum and can be emulated as such.
- Importance of certification and means to earn one should be included across the curricula.

4. Policy recommendations and concluding remarks

We sought to understand the current landscape of training programmes with the aim to propose training curricula standardisation for the servicing sector. Based on our analysis of the sector, we identified four priority areas and proposed NOSs based on these priority areas. These priority areas were derived keeping in mind the future needs of the sector and government's priorities in the last few years. Five government programmes were compared within the purview of the four priority areas that we identified. Finally, we made suggestions for improvements required in the curricula and recommended four NOSs.

We recommend the following to be taken into consideration for curricula standardisation:

- I. Curricula development for the RAC servicing sector requires coordination between the Ozone Cell (MoEF&CC), ESSCI (MSDE) and industry associations to ensure all aspects of skill development and emission reduction are included in training programmes.
- II. Government programmes that are already NOS compliant must consider incorporating priority areas identified in this brief for future upgradation.
- III. While private sector training was not addressed in this brief, these curricula should align with the NOSs based on the priority areas recommended in this brief. For this, the MSDE or the Ozone Cell could create a soft mandate for compliance among the various industry stakeholders.
- IV. Standardising training curricula is a complex task requiring considerations for the many types of refrigerants and equipment available currently and in the future. Given that the technology evolves continuously, curricula development is a continuous process of revision. This demands the establishment of a committee of experts that periodically update the curricula employing the NOS framework and priority areas defined in this brief.



V. This brief did not discuss skill assessment, but it is imperative that all tests for certification include these four priority areas. A knowledge of these priority areas can be considered the minimum criteria for every technician to qualify for jobs in the sector.

A number of training programmes in the RAC servicing sector landscape cater to the technician's need for acquisition of skills, knowledge on cooling equipment, and performance of job roles. A lack of standardisation of skill sets has resulted in technicians acquiring a differential set of skills. This, in turn, has manifested in a range of issues from the mismanagement of refrigerant gases to the tardy pace of industry-wide formalisation. We have proposed in this brief how the existing curricula can be aligned under the NOS. Given that NOSs are not only sector-specific but also apply to specific job roles, we have identified the priority areas that are relevant to all jobs within the sector. Further, we propose a few NOSs and some guidelines for developing this based on extensive review of literature and some stakeholder consultations.

Training programmes for servicing technicians forms one component of the overall transition roadmap for the RAC sector. However, it plays a critical role in the reduction of emissions as well as India's larger mission for skill development. The priority areas were identified based on India's mandated transition under the Kigali Amendment to the Montreal Protocol, as well as our domestic skill development agenda. The resultant NOSs promote the need for adherence to GSPs and safety and are also aimed at creating sufficient awareness on alternative refrigerants. Training in employability skills and career development are essential to empower service technicians and, in turn, necessary for the overall development of the sector.

References

- Agarwal, R. S., Ankur Khandelwal, C. J. Mathew, and Ringkhang Muchahary. 2018. *Good Service Practices and Installation of Room Air-Conditioners with HCFC-22 and Flammable Refrigerants: Technicians Handbook*. GIZ GmbH.
- Agarwal, R. S. 2004. "Upgrading ITIs and ATIs." *ECO-COOL: The Quarterly Bulletin for Refrigeration Technicians*, December 2004. <http://www.nccopp.com/newsletter.asp>.
- Agarwal, R. S., Surinder Batra, Stefan Kessler, Othmar Schwank, and Myriam Steinmann. 2005. *Human and Institution Development in Ecological Refrigeration (HIDECOR): Achievements and Experiences 2001–2004*. Ozone Cell, MoEF, Government of India and Swiss Agency for Development & Cooperation, Government of Switzerland: A HIDECOR Publication.
- Batra, Surinder. 2004. "HIDECOR: A Brief History." *ECO-COOL: The Quarterly Bulletin for Refrigeration Technicians*, December 2004. <http://www.nccopp.com/newsletter.asp>.
- Bhasin, Shikha, Apurupa Gorthi, Vaibhav Chaturvedi, and Torgrim Asphjell. 2019. *Acting on Many Fronts: Incentives and Regulations to Phase-down HFCs in India*. New Delhi: CEEW-NEA. <https://www.ceew.in/sites/default/files/CEEW-Incentives-and-Regulations-to-phase-down-HFCs-report-PDF-06Mar19.pdf>.
- Chaturvedi, Vaibhav, Mohit Sharma, Shourjomoy Chattopadhyay, and Pallav Purohit. 2015. *India's Long Term Hydrofluorcarbon Emissions*. New Delhi: CEEW-IIASA.
- Chaturvedi, Vaibhav, and Lekha Sridhar. 2016. *Economy-Wide Costs Versus Cost to the Multi-Lateral Fund : A Comparison of CEEW-IIASA and TEAP Cost Estimates*. New Delhi: CEEW-IIASA.
- Devotta, Sukumar, Rolf Huehren, Atul Padalkar, and Shashikant Juvekar. 2013. *Good Practices in Installation and Servicing of Room Air Conditioners—Refrigeration and Air-Conditioning (RAC) Technicians Handbook*. HPMP. Germany: GIZ GmbH.
- Directorate General of Training. 2018. "Mechanic Refrigeration and Air Conditioning: Craftsmen Training Scheme." Central Staff Training and Research Institute, Ministry of Skill Development & Entrepreneurship. <https://www.nqr.gov.in/sites/default/files/Curriculum%20-%20Mech.%20Ref.%20%26%20Air%20Conditioning.pdf>.

- Executive Committee of the Multilateral Fund. 2018a. *Draft Report of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol to the Thirtieth Meeting of the Parties*. UNEP.
- Executive Committee of the Multilateral Fund. 2018b. *Final Report of the Evaluation of the Refrigeration Servicing Sector*. UNEP. <http://www.multilateralfund.org/82/English/1/8211.pdf>.
- Green, Denis. 2006. "How Refrigeration, Heating, Ventilation and Air Conditioning Service Technicians Learn from Troubleshooting." PhD thesis in Education, Oregon, USA: Oregon State University.
- Mallick, Deepankar. DGT, MSDE, GoI—Circular. 2019. "Implementation of Revised Curricula of Employability Skills under the Craftsmen Training Scheme (CTS) w.e.f. August, 2019 Admission," August 2019.
- NSDC. nd. "Manual for the Development of National Occupational Standards and Qualifications Packs Draft 8." Ministry of Human Resource Development. https://www.nsdcindia.org/sites/default/files/files/QP_NOS_Development_Manual.pdf.
- Ozone Cell. 2017. "HCFC Phase-out Management Plan Stage—II." New Delhi: Ministry of Environment, Forest and Climate Change, Government of India. <http://ozonecell.in/wp-content/themes/twentyseventeen-child/Documentation/assets/pdf/1492070012663-HPMP-STAGE-II-LAUNCH-2017-BOOK.pdf>.
- Ozone Cell. 2019. "India Cooling Action Plan." New Delhi: Ministry of Environment, Forest and Climate Change, Government of India. <http://www.ozonecell.com/viewsection.jsp?lang=0&id=0,256,815>.
- Prasad, Sharda, Santosh Mehrotra, RL Singh, Ashoka Chandra, Jawaid Ashraf, Kuldeep Goel, and Sunita Chibba. 2016. *Report of the Committee for Rationalization & Optimization of the Functioning of the Sector Skill Councils*. Volume I. New Delhi: Ministry of Skill Development and Entrepreneurship. <https://www.msde.gov.in/assets/images/ssc-reports/SSC%20Vol%20I.pdf>.
- Press Information Bureau, Government of India, MoEFCC. 2016. "India Welcomes Landmark HFC Agreement at Kigali." Government of India. www.pib.gov.in. October 15, 2016. <https://pib.gov.in/newsite/PrintRelease.aspx?relid=151685>.
- Purohit, Pallav, Lena Höglund-Isaksson, Imrich Bertok, Vaibhav Chaturvedi, and Mohit Sharma. 2016. *Scenario Analysis for HFC Emissions in India: Mitigation Potential and Costs*. New Delhi: CEEW IIASA.
- Sridhar, Lekha. 2017. *Standardising Practices in the Air Conditioner Servicing Sector*. New Delhi: CEEW.
- Sridhar, Lekha, and Vaibhav Chaturvedi. 2017. *Can India's Air Conditioning Service Sector Turn Climate Friendly? Evaluation the Skill Gap*. New Delhi: CEEW.
- ESSCI. 2016. "Qualification Pack—Occupational Standards for Electronics Industry." NSDC, MSME. https://nsdcindia.org/sites/default/files/QP_ELE-Q3102_CONSEL_FieldTechnician-Airconditioner_16-6-17.pdf.

Annexure 1

Good servicing practices for refrigerant handling

1. Recovering refrigerant from the sealed refrigeration system or venting and removal of leftover refrigerant like HC 290, which has insignificant impact on environment.
2. Repairing/replacing inoperative spare parts.
3. Cleaning/polishing and flushing the system.
4. Careful brazing and/or flaring of tubes.
5. Leak and pressure testing.
6. Evacuation and vacuum holding.
7. Refrigerant charging.
8. Sealing the process tube and/or closing the valves.
9. Routine checking for proper operation.
10. Recording the details of work done.

Source: Agarwal et al. (2018).

Annexure 2

Stakeholder interviews

Purpose: To gain access to information on training curricula and their usefulness in imparting knowledge and skills to service technicians.

Semi-structured questionnaire

I. General information

1. What training programme have you been involved with?
 - i. GIZ (HPMP I and II)
 - ii. ESSCI (RPL, Skill India)
 - iii. Industry Association (RASSS, RAMA, ISHRAE)
 - iv. Companies (Urban Clap, LG, Daikin, etc)
 - v. Other (provide name and description)
2. How many years has this training been conducted? _____ years
3. What is the length of the training programme? _____ days/ weeks/ months/ years
4. Indicate if the following technical concepts are included in the curriculum:
5. Indicate if the following technical concepts are included in the curriculum:
6. When was this last updated?

7. What teaching resources (manuals, presentations etc.) are used in this training? Where can these be accessed?
8. What is the minimum qualification required for this training?
9. What are the career opportunities for personnel trained in this programme?

II. Training and Curriculum features

1. What language is the training material available in? What language is used to teach?
2. Are there additional steps you take to make the curriculum more accessible to the technicians?
3. How do you encourage technicians to employ GSPs in their everyday jobs?
4. Does the curriculum include transferable skills/ additional skills for job opportunities during off-season?
5. Is there a formal evaluation at the end of the course? Who conducts it? Is there a proof of evaluation?
6. Are there sufficient amenities to carry out the best quality of training?
7. Are incentives given for attending the training? Are these useful as motivators?
8. What are some unique features of this training curriculum?

| Topic | Theoretical [(Yes/ No) + Specify time allotted] | Practical [(Yes/ No) + Specify time allotted] |
|--|---|---|
| Environmental impact of refrigerant gas and AC | | |
| Customer interaction | | |
| Career development | | |
| Entrepreneurship | | |
| Safety aspects | | |
| Insurance schemes | | |
| Other (please specify) | | |




In the years to come, India needs a servicing sector that is technically skilled, environmentally conscious and gainfully employed.



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