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The second hand market for air conditioners in Metro Manila

Business models, resource use, policy options

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1. Introduction: Relevance of the second hand AC market for the Philippines

The demand for global space cooling and, correspondingly, the sales numbers of room air conditioners (AC) are soaring, especially in tropical middle income countries such as the Philippines. Energy demand for space cooling is expected to triple globally till 2050 (IEA 2018). The room air conditioner market in the Philippines was already sizeable with approx. 700,000 new units sold annually in 2016, and increasing to approx. 900,000 units in 2018 (GIZ 2019; Statista 2020). Growth trends in the room air conditioner market are expected to continue strongly on the back of more home staying activities, in spite of overall economic impacts of the Covid-19 pandemic.

These market dynamics present a challenge from an energy security perspective, but also from a climate change perspective. Global warming effects deriving from both electricity use of ACs (if non-renewable electricity source) and climate-harmful refrigerants in the AC are tremendous. Globally, energy efficient, climate-friendly cooling could save up to 8 years of global emissions at 2018 levels (IEA 2020). For the Philippines, cooling sector emissions are expected to rise from 24.7 MtCO₂eq in 2017 to 44.6MtCO₂eq in 2050 in a business as usual scenario (GIZ 2019).

In parallel, positive impacts of AC ownership and use on human development are fairly clear. Studies have found better health (sleep, disease control) and higher productivity in cooled environments (Khosla et al. 2021). A growing AC market has positive employment effects on local technician and service enterprises. Moreover, many livelihoods depend on formal and informal scrap dealing and recycling of e-waste, including ACs. Therefore, an emphasis to forego the purchase of ACs should not be the primary political strategy in tropical middle income countries, but rather a market transition to green ACs. Green ACs can be energy efficient and contain climate-friendly refrigerants such as R290.

Policymakers and technical cooperation agencies around the world tend to focus either on active phase-in of such new green technologies or on the end-of-life (e-waste) stage, neglecting the stage in between. The decisions if, when and how to speed up the phase-out of old appliances deserves more attention. In many low and middle income countries, large second hand markets for used appliances such as ACs exist. From an energy and climate perspective, phasing them out of the market as quickly as possible is desirable. However, a material resource and lifecycle lens changes the picture.

Repairing, reusing and recycling used ACs can make sense from a lifecycle perspective of the unit and to support the move towards a circular economy. Thus, the existence of a second hand market is not necessarily bad. The key question then becomes: *When and how to regulate the second hand AC market to balance energy, climate, resource and social impacts?* This report contributes to answering this question with an analysis of the second hand AC market in Metro Manila. It analyses prevalent business models, sales, prices and customers as well as energy efficiency and resource use. Policy options for balancing environmental and social goals will be derived.

While it is hardly possible to reliably quantify the size of the market for used or “second hand” room ACs in the Philippines, it is safe to assume a substantial market size that requires political attention. According to the Refrigeration and Air Conditioning Technician Association of the Philippines (RACTAP), there are approximately 5, 000 AC technicians in Metro Manila alone, possibly more, as not all are registered with RACTAP. Many technicians are also retailers of ACs. A conservative estimate: if only half of these 5,000 retailer-technicians sold 20-30 used AC units per year, this would already amount to 50,000-75, 000 second hand ACs sold in Metro Manila alone. Extrapolated to all of the Philippines, the numbers of used ACs sold annually could likely reach 200, 000 – 300, 000, roughly a third of the market for new units.

This report draws on 29 semi-structured interviews with second hand retailers and technician-retailers as well as 10 background interviews with experts and members of government. Interviews were conducted between March and November 2020. Respondents were assured that their answers remain anonymous; statements are therefore mainly summarized and interview quotes attributed to a randomized numbering of interviews.

2. Material use vs energy efficiency and carbon footprint?

The challenge in regulating the used AC market lies in finding the most suitable point in time and the most suitable combination of measures to phase-out inefficient, climate-harmful devices without increasing material resource use and waste, and without jeopardizing social livelihoods. The final decision whether to prioritize energy efficiency, climate or material resource use goals remains a political one. This section summarizes the technical information available and sketches the theoretical policy options that can be derived when looking at environmental and technical factors only. The remaining sections of the report give more insights into the social factors to consider.

There are no studies available for the Philippine residential AC market that undertake a lifecycle analysis of different environmental impacts of ACs currently available in the first and second hand markets, including repair and reuse. The factors that such a technical analysis would need to calculate are (based on Karkour et al. 2020):

- Energy mix of the country (where AC is manufactured and where it is used)
- Resource use in production (e.g. steel, iron, copper, nickel, water consumption)
- Resource use in maintenance, repair and recycling (e.g. spare parts)
- AC use time and temperature setting for cooling (electricity)
- AC lifetime (allowing for different maintenance and repair/reuse pathways)
- Direct greenhouse gas emissions (due to refrigerant leakage and improper recycling/burning)
- Indirect greenhouse gas emissions (due to electricity consumption)
- End of life impact on air pollution, soil contamination (type of landfill, waste burning or recycling)

Available lifecycle analyses for other middle income countries such as China, Indonesia and India have found that energy and climate impacts are highest during the use stage of the AC, not the manufacturing or sales stages (Gupta 2021; Karkour et al. 2020; Zhao 2015). Steel and copper have the greatest influence on environmental resource footprint during AC manufacturing (Almutari et al 2015).

A lifecycle analysis of three AC types in Indonesia took both environmental impacts and positive benefits on health into account. Tables 1-3 show the set-up and key results. In this study, the use stage has the highest global warming potential due to electricity use (90%). The study calculated an average run-time of 2hrs per day, not accounting for temperature settings, regular cleaning or repair requirements (maintenance). Indirect emissions from electricity use (primarily fossil fuels in Indonesia) are higher than direct emissions from refrigerant leakage. Copper and nickel are responsible for the largest share of resource consumption impacts (50%) and also have the highest price due to being more scarce than iron, for instance. Looking at AC parts in more detail, the compressor and the heat exchanger (copper and iron) make up the largest share of the resource footprint.

On environmental costs vs human benefits, the authors found that the share of materials costs are lowest during a 10year lifespan (1-3% only). The inverter AC has the highest benefits, mainly due to the low impact in the use phase (Table 3). With the best available configuration of the various resource

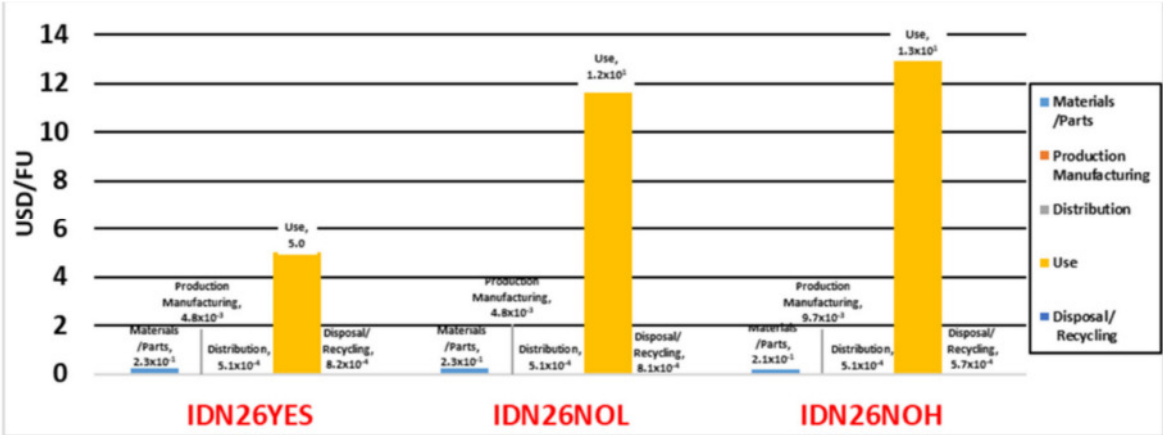
and benefit factors going into the equation, ACs in Indonesia can cover half of the impacts due to their use (benefit/cost = 0.53). A switch to a low-carbon energy mix would make the benefits higher than the costs in Indonesia (Karkour et al. 2020). The Indonesia study concludes that a shift to ACs with climate-friendly refrigerants and the recycling of old units as quickly as possible is advisable.

Table 1: Summary of AC models in Indonesia lifecycle analysis by Karkour et al (2020)

Parameter	Model Name		
	IDN26YES	IDN26NOH	IDN26NOL
Inverter	YES	NO	NO
Refrigerant	R32	R32	R410A
Cooling Capacity (kW)	2.6	2.6	2.6
Weight (kg)	43	42	40
Yearly operating time (h)	4400	4400	4400
10-year electricity consumption (kWh)	13,780	31,770	36,030

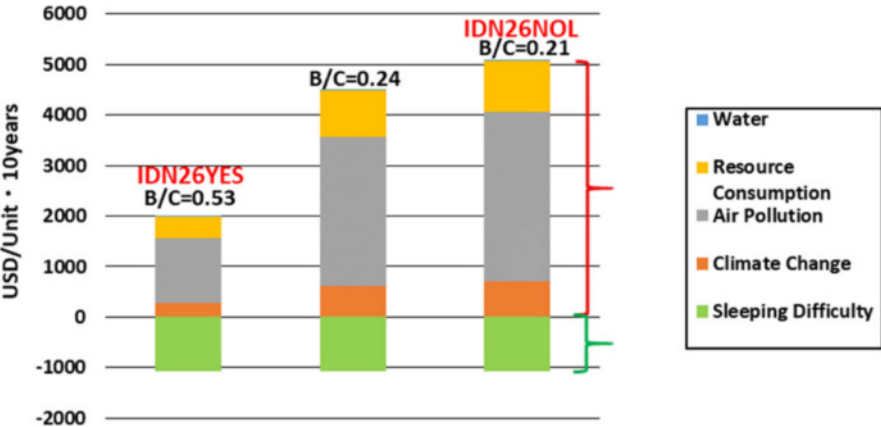
Source: Karkour et al. 2020, p.4

Table 2. Monetary valuation of environmental impacts in USD of AC life stages



Source: Karkour et al. 2020, p.11.

Table 3. Integration of cost-benefit calculation of different AC models in Indonesia (10 year use)



Source: Karkour et al. 2020, p.12.

In the Philippines, ACs also have an average lifetime of about 8-10 years (likely prolonged by repair and reuse in the second hand market by approx. 3-5 years). The majority of electricity used comes from fossil fuels as well (84% in Indonesia, 80% in the Philippines). The refrigerants in the Indonesian study are those that are currently most available in the Philippines first-hand market (R32 and R410a). This enables a general comparison to the situation in the Philippines, even if specific models and use conditions may differ. For an assessment of used units, impacts of repair and replacement of parts as well as differences in electricity use intensity, especially for inverters, according to run time, temperature setting and cleanliness matter as well.

In the Philippines, ACs with the most climate-friendly refrigerant R290 are not yet available. Globally, units with R290 currently are not always the most energy efficient models on the market yet. Due to economies of scale in manufacturing and still limited demand, manufacturers tend to offer more inefficient units with R290 at competitive prices to other units. This creates another level of complexity for the phase-in of green ACs. For the second hand market of ACs, this implies that used ACs with other refrigerants and varying degrees of energy efficiency will likely remain available for decades.

Regarding the recycling of the unit and materials, the Indonesia study leaves some open questions. First, the analysis stops once metals have entered a first stage of recycling and reuse, e.g. by scrap dealers, without following up further. Second, the additional amount of waste produced (especially plastics) has not sufficiently entered the equation, given that not all parts of the AC can be recycled and environmentally ideal waste and recycling systems may not (yet) exist. Finally, the statement to recycle used units as quickly as possible remains somewhat generic, making it hard to identify a concrete, suitable point in time for intervening in the lifecycle of used AC.

In spite of the difficulties in technically assessing the costs and benefits of second hand ACs in the Philippines, first policy directions in terms of timing and combination of measures can be derived:

- Energy and climate goals prevail over resource footprint concerns (unless copper and nickel become scarce)
- Particularly the electricity footprint of second hand units needs to be reduced (climate goal, energy efficiency & energy security goals) i.e. target AC usage behaviour, renewable energy supply

- If a disposal and recycling system for used ACs (e-waste and plastic) is in place: short-term intervention to reduce number of ACs in the second hand market, e.g. by impeding used units to enter the second hand market on a larger scale, or by completely banning the market (e.g. fine and incentive for proper disposal/recycling)
- If a disposal/recycling system needs to be established: immediate, short-term focus on increasing energy saving and energy efficiency (of second hand units and user behaviour) and on stopping refrigerant leakage; mid-term focus on speeding up phase-out of old units
- Repair and re-use of AC parts, single units and materials need not be strictly forbidden, but phase-out of old units made attractive to shorten overall lifetime in the used market

These theoretical options now need to be put into context with the actual situation “on the ground” in the used AC market, also considering affordability and access to cooling as well as livelihoods connected to the business.

3. Business models in the second hand AC market in Metro Manila

3.1 Second hand shops and technician-retailers

The market for second hand air conditioners in Metro Manila is primarily situated in the semi-formal and informal sectors. Semi-formal sector here means: The AC technicians belongs to a larger, registered business, but sell second hand air conditioners on the side; or the micro or small enterprise is registered, but does not pay all taxes; or it is only registered with the Department of Trade and Industry (DTI), but not the Local Government Unit (LGU). Several fully formal, registered air conditioning enterprises engage in the second hand market as well.

The businesses in the second hand market are micro and small enterprises, ranging from an individual technician to a small enterprise with 1-7 staff members. Staff are often family members, but also hired labourers or sub-contracted technicians for fixed time periods. Only one enterprise interviewed can count as a medium-sized enterprise with 80 staff in high season, composed of both trained technicians and unskilled labourers.

The used AC business is very seasonal with substantially more and faster sales during the hot season in Metro Manila (February/March till end of May) than in the cooler or rainy months. During the low periods for sales of second hand units, maintenance and repair services become more important for most enterprises and individual technicians.

Most of the second hand shops or individual technician-retailers maintain several lines of business. Services offered include buying and selling of second hand ACs and its parts, repairing broken units or reassembling them to then sell, and selling the scrap that cannot be reused anymore. Some also buy and sell parts only like compressors, for instance. Individual technician-retailers may work as service technician for a large AC company, e.g. Daikin or Koppel, and repair and sell used ACs on the side, obtained from clients whom they service as part of their primary occupation.

The competition in the second hand AC market is strong as profit margins are high. This forces especially business with employees to try and gain a competitive advantage. Individual technician-retailers tend to be less strategic, but rather opportunistic and flexible in adapting their mode of operations and services depending on whether a used or broken AC or parts of an AC are available. Some of them also simply sell broken or used ACs to the larger players in the second hand market. All small enterprises active in the market try to find an advantage over competitors. These include the type of units and services offered, a warranty including free repair services, offers of discounts by not

issuing receipts or when trading in old AC, and general investments in stable customer relations. In the Manila port area, hardly any difference between business models exists and shop owners do not seem to have a concrete strategy to attract customers.

Giving warranty is not standard in the second hand market, but may count as a sign of technical expertise of the retailer or retailer-technician. Warranty periods given vary widely between 30 days and 6 months for used units, and go up to 1 year for new units. Usually, warranty is only given for the whole unit, not the parts. A few businesses only give warranty if the client agrees to let the technician install and service the unit for an additional charge. One respondent explicitly mentioned not giving warranty on inverter units as these are prone to malfunction due to their sensitive electronic boards (interview 24, March 11, 2020).

Overall, the used AC market in Metro Manila is dominated by three to four larger players who have preferential access to second hand AC sources. Among these larger rivals, respect and friendly competition prevails, whereas stronger competition exists among the many smaller second hand shops and technician-retailer, also called “moonlighting technicians” (e.g. interview 13, March 14; interview 23, November 16; interview 30, October 29, 2020). Connections to middlemen and brokers are key in the procurement of used units (see Section 3.2).

Due to the impact of the Covid-19 pandemic, many businesses had to adapt their business models temporarily due to low sales, shifting more to maintenance and repair or repairing and upgrading the stock they still have to sell once the market picks up again. Some of the businesses had to close down already.

3.2 Sources of ACs and middlemen

The procurement of used AC units (broken and functioning) present the beginning of the second hand value chain. Understanding the sources of the units themselves as well as the role of middlemen or brokers who organize the supply to the second hand enterprises are important elements for any regulatory approach targeting the second hand market.

Sources of used ACs are primarily condominium buildings, hotels, office buildings and larger restaurants that renovate or are reconstructed or demolished. A few retailers obtain used ACs at government auctions. Replacement of ACs in the homes of individual customers also happens with the technician taking the old AC for repairing and/or reselling, but this only constitutes a small market share. Previously, illegal imports of second hand ACs from Japan could be found in the Manila port area, in line with the tradition of Japanese surplus shops for all other kinds of goods. Upon the visit of the port area in February 2020, hardly any Japanese ACs could be found. Retailers gave the extra cost for a converter as a reason or preferred not to say what happened and whether they get any more ACs directly from the shipments (e.g. interview 12, March 3, 2020).

Brokers and partly family networks are key in the procurement of second hand ACS for the retailers, as all interviewees mentioned. Brokers or middlemen have connections to demolition companies and the construction industry. Some larger retailers maintain connections to government property custodians, big firms, hotels and exporters in the export zones directly themselves. Retailers pay the middlemen for the used ACs. They also pay a small “finding fee” of 250-500P to tipsters (e.g. security guards, janitors, maintenance staff) who locate or bring used ACs to them. Bribes play a significant role in the market in access to middlemen and their goods, to the construction industry or to win auctions. Larger players in the market are known to be able to pay substantial bribes: “They have the financial

muscle to pay bribes and higher commissions to third-party brokers like engineering heads, supervisors and the like” (interview 13, March 14, 2020). Many respondents agreed that bribery or “tokens of gratitude” (e.g. interview 17; November 21, 2020) are standard in the business of used ACs.

In the port area, family networks tend to coincide with religious orientation of the shop owners (interviews 8, 9, 12; all March 3, 2020). The ties to middlemen are described as usually stable and based on reciprocity. A few larger second hand retailers also sell to technicians or shops in the provinces, turning into middlemen this way themselves. Additionally, there exists a certain informal code of honour among all retailers: to pass on customers upon request, to remain in friendly competition and to not divulge the shadow system with brokers and bribery in detail to outsiders (interview 10, March 4, 2020). Here again, reciprocity presents a strong behavioural component of the market.

3.3 Repairing and end of life

Generally, AC technicians and second hand dealers repair and reuse all the materials possible. The items they cannot use are sold to (informal) scrap dealers who pass by, sometimes even at a very low price just to free up space. They take out the copper wires, other metals such as nickel and useable parts including compressors to re-use and refurbish as much as possible. The plastic parts often cannot be reused and are taken to the landfill (or just put in some junkyard close by). The majority of enterprises and technicians interviewed assemble and sell “new” units from various scrapped ACs, parts acquired over time and – less so – from a mix of used and new parts. Some enterprises also offer repair services for other appliances such as washing machines or rewind motors. A few technician-retailers are specialized in selling used compressors and other used parts of ACs.

The type and brand of an AC matters for the extent to which it becomes a resource for reuse. For repair and reuse purposes, window-type room air conditioners are preferred as they are generally said to have more durable parts than split-type and inverter ACs. Therefore, fewer inverter ACs are available in the scrap/reuse market. Panasonic ACs, especially inverters, can hardly be found at all – neither as second hand unit nor as scrap item that can be dismantled and parts reused. New, first hand Panasonic ACs count as particularly durable, lasting approximately 10 years in primary use – but after this time period, the parts are so worn out that they cannot be reused at all (interview 10, March 4, 2020). Some AC parts are interchangeable across specific brands such as Carrier and Koppel, making these models and their parts particularly popular among technicians and retailers.

The repair and reuse procedures can include some questionable practices. The restoration of old units or assembly from parts may include an “upgrading” to a higher class model, i.e. a class B unit is then sold as a class A model, or a used unit is sold as a completely new one. Some shops or technicians-retailers clean and polish the used ACs and wrap them in plastic to make them appear new. The customer usually cannot tell the difference. A few technicians-second hand dealers are specialized in selling used compressors and refurbishing compressors and/or ACs, either sell the compressor or a whole refurbished AC unit. This may include re-branding, putting false serial numbers and polishing/re-packaging the AC to sell at a higher price.

Once parts of ACs are deemed unusable or invaluable by retailers and technician-retailers, either scrap dealers pick up or receive the remaining parts, or the retailers bring them to junkyards or landfills. For the (informal) scrap dealers, copper and nickel as well as other metals present the most precious parts of an AC. These are usually dismantled or scraped out manually as even the larger enterprises lack the

appropriate machinery for this kind of waste separation and recycling. Larger scrap dealers and wholesalers attend governmental auctions, for instance in Valenzuela City and Mandaluyong City. When they buy scrap from technicians or second hand dealers, they sell the metals on to the smelting plants situated on the outskirts of Metro Manila. Before the Covid-19 pandemic, the price for scrap was 350P per kg; during the Covid-19 pandemic, the price dropped to about approx. 220P per kg.

Only few LGU have recycling sites for materials in Metro Manila and hardly any formally registered companies operate for ACs. There is only one accredited collection, transport and storage facility that can handle climate-damaging refrigerants. Additionally, some recycling sites in key industry areas and in the special economic zones with a more established system for hazardous waste exist. Existing drop-off stations for e-waste focus on smaller appliances this far, as do the public and civil society initiatives and campaigns active in the field this far. Here, a significant policy gap exists.

The public awareness of these recycling opportunities and general recycling pick-up services in some LGUs such as Valenzuela is still low, especially among households and other customers. The second hand shops and technician-retailers interviewed tend to stop thinking about what happens to the materials once they sell them to a scrap dealer or dispose them at a landfill or junkyard. Some of them are aware of recycling sites and/or comply with the regulations for hazardous waste (see Section 6), but the vast majority do not extend their conscious business practices to the final stage in the lifecycle of an AC. For them, there is no incentive or business case to engage in the proper disposal of refrigerants. This study also did not further investigate the end of life stage of ACs in more detail, following the paths of the various materials and their further reuse, recyclability or potential for proper disposal beyond the second hand retailers.

4. Sales, prices and customers

4.1 Types and volume of AC sold

The vast majority of shops and technician-retailers sell both window-type and split ACs, with window-type units slightly more common still. This reflects the overall market share that window-type units still have in the Philippines (62%, GIZ 2019). Carrier, Koppel and Kolin are the most popular brands, but also Daikin and – less so - Midea, LG, Panasonic can be found. Units with smaller motors (1-1.5 Horsepower/HP) are common, whereas units with more than 2 HP cannot be found much in the second hand market. Used split-ACs with inverter technology are also less common in the second hand market this far.

The brands Carrier, Koppel and Kolin tend to sell most for window-type used units; Carrier and Koppel for split-type ACs. One shop also specialized on the vintage brand Alenaire. A few businesses sell commercial units and compressors only, mostly the brands Copeland, Matsushita and Bristol. Panasonic compressors are less available. Compressors both within re-assembled units and sold as parts are sometimes re-branded or receive fake serial numbers (as stickers) to make them appear new or to be of a different brand. This kind of cheating practice is invisible to the lay customer and serves to increase the price and perceived quality of the product.

Stock generally sells fast, especially during the hot season with 1-3 days of stock turnover on average. In low season (non-Covid), 10-14 days are common till stock is sold. Stock visible in stores upon visit ranged from a handful of units to up to 30-40 units, or, in the case of retailers specialized on compressors, several shelves lined with compressors. It is not possible to give a specific number of

stock and sales turnover as respondents were reluctant to share this information in detail. Due to the Covid-19 pandemic, sales numbers plummeted, for some retailers to 1-2 units sold per month. This already forced a few enterprises and technician-retailers out of business. Repair and maintenance services as well as re-assembly projects for later sale serve as a lifeline for business survival.

Customers are mainly interested in price and size of the AC and whether it cools and functions well (durability). While well-known brands such as Carrier and Koppel are popular, the price and the cooling functionality override brand preferences – and usually also energy saving concerns (see Section 5).

4.2. Prices

The prices for a used AC for the end consumer depend on the size, cooling capacity, brand and – to a lesser extent – the outward appearance of the unit. Interestingly, prices largely converge, confirming that this is a well-established market in which demand, supply and competition regulate price levels.

Overall, profits expected range from 50% to 70% plus compared to procurement price, i.e. doubling or tripling investments to middlemen. The exact profit depends on labour costs in the business, the number of AC purchases (bulk prices can be negotiated) and the investments and prices along the chain, including repair costs and scrap prices. Table 3 gives an overview. Large players in the business will invest up to P 1 million, for example at government auctions and in middlemen, expecting profits to triple as whole units are sold to customers, parts left over are sold to other technicians, and scrap sold to scrap dealers.

Price of trade-in units and parts depend on the appearance and age of the unit. Prices of parts vary, as the following examples show. In shop A (interviewed before Covid-19 recession), for example, a R134a compressor costs more than a R404A compressor because the former are in demand. The business sells parts and components like complete set of refrigeration condensing units for P5,000. A new set costs approximately P18,000-P20,000. In enterprise B (interviewed before Covid-19 recession), a used AC is bought for P5,000. All items (body, evaporator, and condenser coils) except the compressor, fan motors & expansion valve, will go to the scrap items. A compressor (original looking) will be sold for P9,000; fan motors for P3,000 each & expansion valve for P3,500. The scrap will yield a value of P4,000 minus labour works. This business benefits most from the sales of equipment and parts. Shop C (interviewed during Covid-19 lock-down) sells a capacitor of 25 micro farads for P100 that sells at regular retail stores for P300 a piece. The retailer sells an external overload protector that regularly costs P250, for P75, and sometimes gives it free to “suki” (loyal clients).

The enterprises that sell both new and used units indicated that between 15 and 35% of their final income comes from the second hand business, explaining why it is so attractive to almost all enterprises or technicians in the field. Individual technician-retailers may have a particularly profitable small-scale side-business, e.g. buying single used units from tenants in the building for P 1000 and selling to new tenants for P 5000. If the fluctuation of tenants is high, the same unit may be re-bought and re-sold several times per year as fluctuation in the building is high. Once the unit breaks down, this individual does not repair but sells the unit at a still high price of P 500 – 1000 to scrap dealers.

Scrap prices depend on the type of material. Copper as the most precious metal within an AC sold at P220/kg for Class A and P200/kg for Class B in March 2020, dropping to approx. P160/kg for both types during Covid-19 lock-down. Iron prices remained stable at P8/kg. Garbage collectors dispose of whole AC units for P100-200. For mixed type scrap coming from hotels and restaurants directly, prices were

reported at up to P350/kg before the pandemic and approximately P250-280/kg during the pandemic. The prices for metals and recyclables still roughly equal those of 2016 (EMB 2016).

Table 3: Average prices in the second hand market for ACs in Metro Manila (in Peso)

Item	Procurement (price paid to middle men or household)	Sales price
AC 1HP (window-type)	3000-4000; broken unit: 500P	5000-7000
AC 1.5 HP (window-type)	3000-5000	6000-8000
AC 2 HP (window-type)	No data	8500-9000
AC 1 HP (split-type)	5 000 - 8000	15 000
AC 1.5 HP (split-type)	No data	28 000
AC 2HP (split-type)	10 000-17 000	20 000-30 000
New compressor	25-32 000	40 000 (with installation)
Used compressor	1500-3000	6000-12 000

Source: Author's interviews.

4.3 Customers

The customer base and their reasoning for buying used ACs present the demand-side of the second hand AC market. Political interventions to change the market dynamics may also need to consider consumer motivations, especially if command-and-control instruments such as bans are not suitable or not easy to implement.

The type of customers buying used ACs are largely similar across Metro Manila. In the port area, retailers' customers are mainly individuals and small shops or restaurants. For the retailers and technician-retailers throughout Metro Manila, the share of individual customers is smaller than those of small enterprises. Restaurants, karaoke bars, small hotels, sub-contractors of fast-food chains, private companies and offices or mini supermarkets present the main customers. Individuals from condominium buildings and individuals passing by or phoning in may also ask for the replacement or trade-in of a broken unit. Hardly any second hand shop or technician-retail can handle bulk orders of many units, but most can deal with an order of a few used units.

As the very poor cannot afford ACs, individual customers are mostly middle-income enterprises or middle class people looking for a bargain. Rarely, richer people ask for a used unit, as most retailers agreed. When it comes to individuals, it is often hard to tell for the retailer who these people are. Car ownership or expensive-looking clothing may give indications, some interviewees pointed out, but for all retailers, the proven ability to pay is more important than the type of customer. One interviewee mentioned that the middle class or rich people want new units in their homes, but prefer to buy used units for their businesses, saying that "used units will do" (interview 21, November 25, 2020).

Customers may also be other technicians or retailers from the provinces like Batangas, Laguna or Bulacan. Particularly the larger retailers entertain a network of "suki", i.e. loyal patrons that are either clients themselves or refer to final clients, other technicians and middlemen in the provinces. The trade of compressors and other AC parts happens between technicians and retailer-technicians, also often based on relations of trust and reciprocity.

The uniting driver for the purchase of a used AC are the lower (or perceived lower) price and the speed and ease of availability of units. Customers seeking to make a bargain are likely to underestimate

maintenance costs and remaining lifetime of a unit by focusing on upfront investment costs. The cost-benefit calculation may be favourable if a used unit costs P 6000, has a warranty and lasts another three years without any repairs. It is not favourable if a more expensive refrigerant like R22 is used, remaining lifetime is short or maintenance costs are high, e.g. for an inverter unit. In those cases, new units from factory outlets outside of Manila are cheaper in the mid- to long-term. For new units bought in regular stores, waiting times of several months are no exception during the hot season. Finally, using second hand appliances, repairing and reusing as long as possible presents the social norm in large parts of Filipino society, especially when affordability is a real constraint for the consumer.

5. Energy efficiency and refrigerant

5.1 Status of the AC in the second hand market

Currently, energy efficiency and the refrigerant in the AC are secondary concerns to both retailers and customers. In the second hand market, very few appliances still have the national energy efficiency label. If the label was still attached to the unit, it was unclear whether it was the original one or transferred from another AC. As some retailers also apply fake labels and serial numbers on (used) compressors, for example, caution regarding energy efficiency labels is unfortunately advisable for customers buying a used unit. Moreover, these re-labelling and to some extent re-branding of parts also casts some doubts whether specifications for the refrigerant contained are always correct.

It is difficult to technically estimate how energy efficient the units arriving in the second hand market still are as respective preceding lifespans, use mode and maintenance are usually unclear. Most technicians agreed that ACs have a lifetime of 5-10 years in the Philippines and that repairing and reassembling them can add another few years – how many exactly is difficult to pin down. Maintenance and servicing of ACs (especially cleaning) play a large role for both the remaining energy efficiency and durability of used ACs.

The majority of used ACs arrive empty of refrigerant at the point of repair and resale, i.e. second hand shops or businesses. This implies that either units were completely empty upon deinstallation or venting/disposal of the refrigerant happens at the building site to be demolished or renovated building, or at the individual customer. If there is any refrigerant left, some retailers or technicians simply vent it. Fewer technicians try to capture the remaining refrigerant and dispose of it for recycling, saying they comply with regulations such as the EMB code on Air Condition Services (EMB 2004). According to the Code, ozone depleting substances (ODS) such as refrigerants in air conditioners shall be recovered with appropriate tools and stored in special containers to be surrendered to any dealer of ODS. Importers of ODS are required to provide adequate recycling facilities. Exactly how this process happens in the second hand market remained unclear in the interviews.

Currently, a range of refrigerants are being used in the second hand market (R22, R32, R410a, R134a and R404a). As the refrigerant R22 is banned from 2021 onwards, ACs using this refrigerant were sold at a cheaper price in 2020 already. A common opinion among retailers and technician-retailers in the second hand market is that many used units with R22 will be available for another 10-15 years as the phase-out in the second hand market happens only gradually.

5.2 Awareness of customers and retailers

As most customers focus on price and cooling capacity, energy saving and energy efficiency does not influence their purchase decision, even if they are generally aware of the issue. In contrast, retailers and technician-retailers in the AC business have a higher awareness and knowledge about energy efficiency than customers, but they do not always have complete knowledge and/or convey information correctly to customers.

Those customers who are inquiring about energy saving sometimes also ask explicitly for an inverter AC. Here, two knowledge asymmetries exist: there are retailers/technician-retailers who advise clients to buy second hand inverter ACs for energy saving reasons (e.g. interview 12, March 3; interview 18, October 29; 2020); and others who explicitly do not do that, but tell clients to consider a new unit instead (interview 13, March 14, 2020; interview 29, October 29, 2020). The second knowledge asymmetry exists between retailers and customers: few clients are aware that inverter ACs require higher maintenance to be energy efficient and are less durable. They have seen commercials of new inverter ACs that advertise their higher energy savings or rely on word of mouth.

In the Philippines, inverter units are only more energy efficient than other split-ACs if they are maintained well and are running for a longer period of time. If they are turned on and off frequently or running for a short time, efficiency advantages can quickly evaporate. Moreover, the sensitive electric circuits in inverters produce need repairs or produce short-circuits quickly, e.g. due to dust accumulating or small animals such as lizards entering the unit. Consumers may end up with more overall costs than with a more traditional split-type AC, even if the electricity bill itself is lower. However, not all retailers are aware of these details either, especially those without any technical knowledge or training.

Few skilled technicians and retailers reflect critically about the overall benefit of used units in the AC market, saying, for instance: “It is better [for energy saving] to buy brand new units, but buying second hand or restored units sometimes makes sense to small establishment with low capitalizations, just for a start-up” (Interview 23, November 16, 2020). The majority of retailers in the market, however, do not think about energy efficiency questions in their daily business.

Retailers’ awareness levels of harmful ODS and refrigerants are generally lower than on oils and other hazardous waste among retailers. Here, there seems to be a clear difference between trained technicians and other retailers or technicians that have not attended much or any training. Trained and skilled technicians tend to be aware of the various hazards. Some retailers and retailer-technicians know that the refrigerants are harmful to the environment and that they should be careful, but do not know why. They either do not know what to do or lack the tools to handle remaining refrigerant appropriately. A few respondents mentioned lacking the tools to capture the refrigerant and do not know how to recycle it or do not worry at all about the refrigerant, oil, chemicals etc. Some shop owners are not aware at all and just pour remaining substances in the gutter. This study did not look at compliance with health & safety, disposal regulations in more detail.

6. Compliance with current regulations

The air conditioning and services market is subject to several regulations and codes of conduct regarding occupational health and safety, phase-out of specific refrigerants (HFC phase-out under Montreal Protocol, ban of R22 and prospectively more ODS under the Kigali amendment), recycling

and disposal of hazardous ways (end-of-life-management). No regulation from an energy transition perspective exists yet. None of the existing regulations specifically target the repairing, sale, use or disposal of used AC units yet. In this sense, practices in the second hand market alternate between legal sales and behaviour, questionable behaviour in a grey zone and failure to comply.

Particularly pertinent regulations include the ban of R22 refrigerant and the aforementioned EMB Code on Air conditioning and Refrigeration Services. Building owners should bring back old AC units for dismantling and proper recycling and disposal, depending on the type of contract, but in a discussion with the DENR, it became clear that compliance to this regulation is very low. Moreover, the current regulation remains somewhat ambiguous, excluding building demolition waste from the hazardous waste disposal regulation (apart from asbestos). A specific regulation on electronic waste, including air conditioners, has been proposed but is still pending at the time of writing.

Generally, compliance with regulations such as the R22 refrigerant ban or the proper disposal of hazardous substances contained in the AC is mixed. The ban of refrigerants has a time lag in the informal second hand market, i.e. gradual phase-out, as ACs containing R22 will continue to enter the market for some time. An effective import ban on R22 for refills will lead to a definite end of usage of this refrigerant, however ACs made for R22 use may still be retrofitted for re-use with another refrigerant by some technicians.

The compliance with the regulation to properly dispose of hazardous waste, e.g. oil, solvents, refrigerants, varies among second hand dealers/dealer-technicians. Many comply – or at least claim to comply – with government regulations and the EMB code. Particularly the trained and certified technicians make an effort in this respect (reported, not verified behaviour). Some of the second hand dealers are not aware of these regulations and codes, others choose to ignore them and pour oil in the gutters and vent the refrigerants, as mentioned before. As this study did not look at compliance with health & safety regulations, no analytical statements can be made on this topic. However, several interviewees mentioned that they are nervous about more controls and fines by DTI/TESDA and therefore consider buying items such as safety shoes.

Those retailers and retailer-technicians who do not comply with regulations and codes believe that the government will never have enough technical inspectors and financial means to control (e.g. interview 21, November 25; interview 32, October 29, 2020). Among most interviewees, trust in government in general and in service delivery by sub-agencies is rather low. The vast majority of respondents favours not only a continued, but also more protected second hand market if the government in turn reliably offered more supportive services, e.g. micro-finance or financial incentives for energy efficient technology replacement.

From a policymaker perspective, ensuring compliance with existing regulation remains challenging. For the end-of-life management of ACs, accessing and managing informal scrap dealers presents a particular challenge. Moreover, more facilities and a more structured system for recycling of materials and refrigerants may be required. The following sections discusses options for political interventions in the second hand AC market along the different stages of the business chain.

7. Policy options

The balancing of energy, climate, materials resource and social aspects in the second hand AC market requires the appropriate timing and combination of measures. Overall, the improvement of second hand market, repair and reuse of ACs to foster more positive development effects in line with a circular economy approach is desirable. The exact point in time in the lifecycle of an AC where environmental and social costs and benefits are on par is difficult to identify without deeper technical analyses of AC units in the Philippine second market.

The analysis in this report has shown that short- to mid-term regulations and interventions are more appropriate than postponing to the long-term or foregoing any regulation. From an energy and climate perspective, phasing-out used ACs as quickly as possible is desirable; from a social and waste management perspective, allowing for a short prolongation of an AC life by approximately 1-3 years is more attractive than no affordable ACs and lost jobs. Ideally, all very old AC units, for example those entering the used AC market for a second time or broken units with more than 3-5 years added lifetime after primary use (i.e. 8-10 years) should be phased out quickly.

The following policy options could be explored:

- **Ban second hand market: not useful** because a) resource waste/waste problem likely to increase as no complete, professionally organized disposal/recycling system in place yet, b) this would deprive many Filipinos of access to an affordable cooling device c) employment/livelihoods in the market would be quite strongly affected, d) second hand market would only become completely clandestine then.
- **Regulate construction industry & building demolition:** Change building code/demolition and waste regulation to a) enforce AC and refrigerant disposal as hazardous waste, b) set fines for middlemen who do not comply, c) develop and set clear conditions which used AC units can enter the second hand market (e.g. based on age, type and horsepower of unit, refrigerant) and which used ACs are banned from any reuse. For example, it could be debated whether units with a lot of horsepower or suitable for large rooms only need to be available at affordable prices.
- **Set-up of professional reuse and recycling scheme that integrates the second hand market:** This would require more specific electronic waste regulation and the development of an Extended Producer Responsibility (EPR) scheme, possibly complemented by a used AC rebate scheme for consumers, technicians and scrap dealers to hand in least efficient ACs (possibly connect with “best repair practice”), see below. Challenge: probably international financial support required for a large-scale rebate scheme.
- **Set-up of an EPR scheme:** technicians and retailer-technicians signalled general openness if privately run (low trust towards government agencies). As the number of AC manufacturers is limited, making the scheme an *individual producer responsibility*, i.e. each manufacturer needs to take care of disposal and recycling for own products rather than paying a fee and organizing a collection system by sector.
- **Reward sales of most energy efficient used ACs and energy-saving repairs of used ACs:** financial incentives at government auctions; behaviour change intervention aimed at technicians and technician-retailers (draw on pride by trained technicians, reciprocity and trust in second hand networks to start a new social norm what “a good used or repaired unit” is)

- **Include used AC units in awareness raising campaigns** on energy saving and energy efficiency, raise awareness on maintenance of inverters (target groups: technicians, retailers, consumers)
- **Innovation prize for establishing (informal) “best repair standard”** to increase an orientation towards energy efficient, climate friendly AC repairs among RACTAP/technicians. This could be a competition or exchange of best practices, using the professional pride of many trained technicians and the reciprocity and trust in the networks. A “trickle down” effect to untrained technicians could be supported, triggering word of mouth and customer awareness.
- **Consider R&D support for AC manufacturers** to integrate more interchangeable parts, make electronic boards more durable, and develop green, energy efficient and low-cost, low horse-power ACs that are easy to repair (low tech models for poorer parts of the population similar to “One Laptop Per Child” Initiative in Africa or Tata Nano development in India’s car market).

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