Introduction of Alternative Refrigerant in the Thailand AC Sector and the Role of Intellectual Property

Case Study

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Thailand AC Sector Case Study and Intellectual Property Rights (IPR)

Outline

- Thailand’s air-conditioning (AC) sector in context
- Challenges in converting to non-HCFC tech.
  - Technology and the market
  - IPR and technology transfer
- Standards and safety
- Component availability
- Brokering solutions that work for all
- Thailand’s experience: A springboard to improved energy efficiency and additional climate co-benefits

IPR

- Intellectual property protection: background and relevance
- IPR in relation to future Montreal Protocol (MP) implementation
- IPR and technology transfer
Thailand’s AC Sector in Context

- 2\textsuperscript{nd} largest residential AC manufacturing base in E. Asia and major export hub: ~ 10 million units/yr (10% for local market) made of multinationals + 14 Thai companies.

- Market somewhat segmented with local companies focused on the domestic and lower-end markets, as well as larger units.

- At project baseline (2012):
  - Sector dominated by HCFC-22 based manufacturing (95% of AC sold are R-22 units), growth at 7%  
  - To meet obligations to the Montreal Protocol on Substances that Deplete the Ozone Layer of 10% reductions from the baseline, Thailand needed to eliminate 8,800 tons of HCFCs under BAU.  
  - 43% of Thailand’s HCFC consumption went towards refrigeration and AC manufacturing.  
  - Critical to address AC sector to slow R-22 demand in manufacturing and downstream servicing.  
  - AC sector has the technology to convert if necessary: R410A (already the technology of choice in developed countries; components and markets assured).

- Project funding considerations – refrigerant technology has to be lower in GWP…
Challenges: Technology and the Market

• Alternative refrigerant technology other than R-410A is new – not tested nor used in developed countries.

• First decision by potential beneficiaries (Thai-owned enterprises): Which refrigerant technology?

• Considerations: R-290 vs. R-32
  • R-290 - Highly flammable, already stigmatized by a high profile accident in Thailand despite voluntary handling standard; high costs in safety measures and training (aftersales)
  • R-32 - Mildly flammable; major manufacturer is developing and testing the technology, moderate costs in safety measures but aftersales training costs also high

• Concerns centered primarily on safety and standards, technology access, market acceptability and competitors, and size of typical AC manufactured.

• Industry prefers R-32 after weighing pros/cons and benefits/risks of the two.
Challenges: Technology and the Market

- R-32 becomes the candidate refrigerant – but not all enterprises are convinced that it + a grant are a better option than no grant + R-410A because of fears:
  - Market acceptability (flammability, costs)
  - Availability of technology
  - Use of / applying the technology in face of capacity and policy constraints

- **Market acceptability** is to be tackled on several fronts: Create confidence and scale through involvement of a major player while assuring small enterprises they will not be shut out of the market, and may gain – together this can overcome the R-410A bias.
  - Dialogue with Daikin leads to agreement that it launches R-32 in the market but timing tbd.
  - Dialogue with Thai industry leads to 6 interested companies (out of 14) that accept some markets (EU) will close if they go to R-410A and are open to learn more about R-32…

- **Availability of the technology** ...R-32 technology is patented by Daikin.

- Another dynamic at play – other multinationals in Thailand were not willing to pay for R-32 and prepared to undermine the technology’s credibility in Thailand.
Challenges: IPR and Technology Transfer

• Intellectual Property Protection
  • A major challenge in view of developing countries for HFC phase down, esp. related to HFOs (could be one of most viable options for mobile and stationary AC).
  • World Bank (WB) study: provide basic IPR understanding, review HFO IPR landscape, clarify related aspects.

• About IPR
  • Patents provide a time-limited monopoly (usually 20 yrs) within a geographic area on both products and processes that have i. novelty, ii. inventive step and iii. industrial applicability.
  • Process in securing IPR using public disclosure fosters more competition for next generation inventions; IPR and tech transfer are a basic part of today’s business
  • Access to patents is critical for development of specific production or manufacturing parameters for making final products with good quality and cost-effectiveness.

• Important IPR Aspects to Consider for Addressing Barriers
  • Process vs. application patents
  • Patent families and priority dates
  • Technology transfer arrangement types (JV, licensing, supply agreement, free access)
  • Prior experiences of technology providers
Challenges: IPR and Technology Transfer

• IPR Study Findings in relation to future MP implementation
  • 30% are application patents for products
    • Equipment-related patents expected to grow
    • Technology clearinghouse on options/patents – patent pooling
    • Multilateral Fund (MLF) experience in funding
  • 70% are process + application patents filed by 5-6 producers
    • IPR will expire starting in 2024-25; by 2028-29, half the patents of
      will be released
    • HFC amendment provides certainty; will drive cost down
    • Arrangements to transfer/access technology already underway;
      MLF might help through new types of support to producers
  • Conclusion: IPR can be a barrier to both patent holders and technology users if the right
    balance in their application is not found – perceived barrier is not unsurmountable and
    opportunities that work for both sides can, are found by the market (various technology
    agreements or arrangements). Information helps.

• IPR and technology transfer
  • Access to patents is only the first step – they describe new products or processes
  • Know-how which is considered confidential is also needed...
Challenges: IPR and Technology Transfer

• In the case of residential air-conditioning, Daikin had already agreed to provide developing countries free access to 93 basic application patents as a means to encourage commercialization for HFC-32 based AC.

• Thai industry is still reluctant – that does not give it know-how. Although technology choice has been made and is accessible thru an agreement with Daikin, there is still the “doing” left which requires intensive efforts and guidance.
  - WBG-Daikin organize a factory visit in Japan for the industry on equipment installation and safety measures
  - Multiple consultations organized with the 14 companies, within the association (Thai AC Club) and bilaterally

• A deal on applying the technology is reached:
  - Daikin agrees to also provide tailored support to participating companies to improve AC quality (“clean-dry-tight” manufacturing approach) during project implementation
  - The return is more reliable, quality R-32 AC market to build confidence in the product and demand as this is new, high-profile – high risk for market acceptability - Daikin stands to benefit, with direct access to the Thai market

• Remaining issues:
  - Thai industry require one last assurance – when will Daikin market R-32 AC in Thailand. Agreement on 2015 is reached after consultations and meetings in DC, Thailand and Japan. One more tour, enterprise balance join.
  - Opposition by other multinational AC manufacturers in Thailand: METI puts pressure on the companies to accept R-32 technology as this aligns with Japanese domestic policy on high GWP gases; Policy needed.
Restrictions on the use of flammable refrigerant in AC in high-rise buildings – would this apply to R-32? Regulatory agencies needed clarity.

- Thailand Council of Engineers, based on request from Department of Industrial Works (DIW), confirms that HFC-32 is not considered a highly flammable substance.
- DIW commissions an independent safety assessment of HFC-32 in split-type AC equipment. Conclusion: HFC-32 can be safely used in a split-type with cooling capacity not over 53,500 Btu/hr (15.75kW) provided the inside unit is wall-mounted.
- WBG reviews ISO-5149-2014 which recommends a max. refrigerant charge size for A2L (mildly flammable) and A3 (highly flammable) refrigerants based on building occupancy category and equipment location. Slide deck is prepared for discussion on revising building code.
- WBG shares experiences of other countries on dealing with HFC-32 refrigerant – primarily Japan’s research: risk assessment studies on HFC-32 carried out by the Japan Refrigeration and Air-Conditioning Industry Association (JRAIA).

Based on tests and evidence, Department of Public Works and Town Country Planning decides to modify regulation to allow installation of split-type AC with capacity up to 36,000 Btu/hr in high-rises. For larger units, consultation is underway.

Who benefits? Thai domestic industry and multinationals.
Challenges: Component Availability and Supply

- Design of refrigerant pathway required a new compressor

- One rotary compressor manufacturer supplying the market for all types of refrigerant compressors in the most popular size range. But for larger TR units (about 10% of the market and belonging to the Thai industry) there was a gap.

- Critical mass and coordinated efforts were needed to convince supplier to produce the R-32 compressor in larger size range – but this was not evident to private sector players who tend to go it alone (competition)
Brokering Solutions that Work for All

- Identification and isolation of the challenge or hurdle
- Systematically addressing the challenge (step by step) while consulting stakeholders all along
- Building consensus among stakeholders by singling out the bottom line/interest of each
- Fostering confidence of policy-makers in new technology through information, particularly that from developed countries

Results

- 2016: 3 Thai AC manufacturers introduce R-32 AC; 30,000 units sold.
- January 1, 2017 ban of >50,000 Btu R-22 AC manufacturing for domestic market.
- Performance of R-32 AC is better than similar R-22 & R-410 units.
- AC Club of the Federation of Thai Industries is a stronger collective, better able to meet evolving market demands as a unified front.
- Lessons on the importance of guaranteeing compressor supply led to a Canadian grant to assist a Thailand reciprocating compressor manufacturer to design and develop R-32 based compressors.
Building from Thailand’s Experience

• Positive experience (new markets, more sales) of Thai AC manufacturers is their motivation to take the next big step - move from fixed speed to inverter technology (also for light commercial AC). Initiatives to support this move are under consideration by Government of Thailand and the WB.

• Thailand’s technology transfer and technical assistance program will serve as a model for other countries with AC companies that want to convert from HCFC-based manufacturing (Vietnam) or improve manufacturing quality (Jordan).

• Treatment of A2L refrigerant for use in residential AC in building codes can be replicated in other countries.

• Spin-off R-32 reciprocating compressor activity (EFO) has laid the foundation for alternative compressor technology in commercial refrigeration and AC, the latter which is essential in high-ambient, harsh conditions. Testing the compressor in the low-GWP refrigerant AC demo in S. Arabia is being explored.

• India request to the WBG for a $200 million loan for transitioning to superefficient AC – the conversion experiences of Thailand re. refrigerant technologies to be incorporated, and potentially benefitting from an established working relationship with multinational AC industry.