

**K-CEP-FUNDED INVERTER  
TECH TRANSFER TO ROOM AC  
MANUFACTURERS AND AC  
SECTOR COOLING PLANS**

*Operationalizing  
EE and HFC  
Phase-down  
Synergies*

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Bangkok



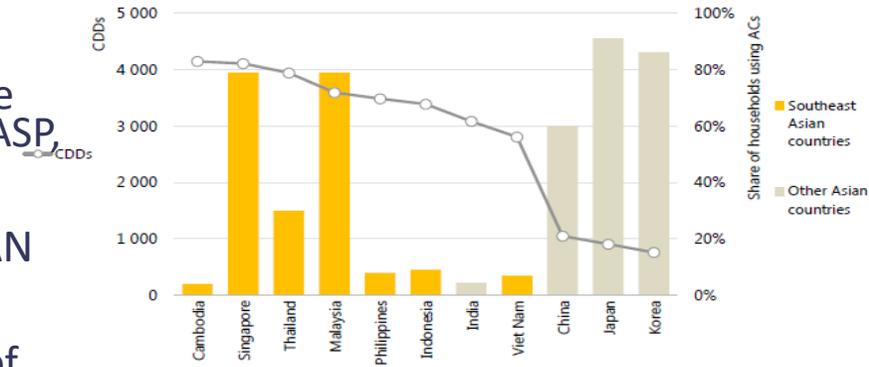
# AC MANUFACTURING READINESS PROGRAM

## Context



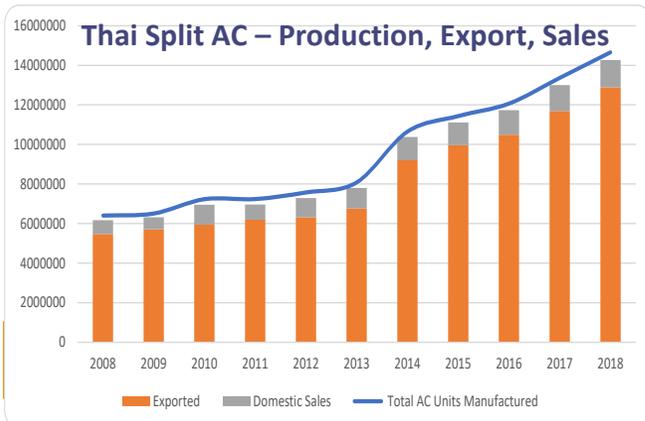
- **Global scale:** Est. 100 m unitary AC manufactured annually (15-16 m in Thailand alone). According to IEA, energy use for AC has increased 7.5 times over 30 yrs in ASEAN countries while AC ownership averages at 15% of households only, leaving a large potential for growth. More heat, wealth & people = demand.
- **Economic importance:** For ex. Thailand, split AC market est. to be \$2.8 billion; more than \$725 million in components exported (CLASP, 2018)
- **Energy consumption avoided:** More EE AC would permit ASEAN countries to save 110 TWh of electricity by 2040 (IEA).
- **Climate imperative:** Majority installed are fixed speed w/either of HCFC-22, R-410A or R-32. W/out maintenance – high energy consumption and leakage = significant CO<sub>2</sub> eq. emissions.

Cooling Degree Days vs. Share of ASEAN Households with AC



Note: CDDs – Cooling degree days; ACs – Air conditioners  
Source: IEA (2019) Southeast Asia Energy Outlook

Why? →



- **Window of opportunity to build on the AC sector R-32 transition** is now - greening *the same* MLF-supported AC industry thru open-access inverter tech., public-private sector partnership and policy enhancement. Region overall is moving quickly to efficient cooling.
- **Leveraging Kigali:** In less than 2 years, potential to align HFC phase-down (in CO<sub>2</sub>eq) from high-GWP refrigerant (R-410A) with transformation of the AC sector to more efficient AC.
- **Low-hanging fruit** due to existing policy framework and market trends (ave. efficiency of AC models and R-32).

# AC MANUFACTURING READINESS PROGRAM

## Program Objective

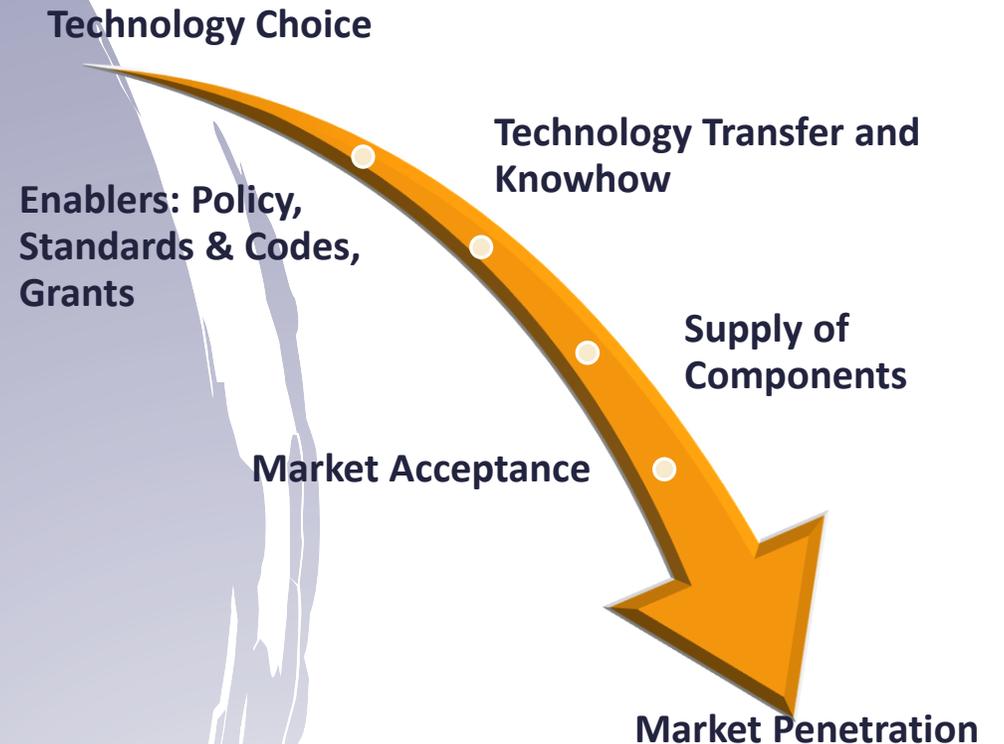
- To develop capacity to adopt lower global warming, high energy efficient technology by local room air-conditioning (RAC) manufacturers and support accelerated transformation of the RAC market in Thailand and Vietnam.
- By:
  - Creating the enabling environment for supply and demand of high EE RAC with lower GWP refrigerants in the domestic markets of Thailand and Vietnam
  - Improving local RAC industry's technical capacity to design EE AC using inverter technology, to increase the confidence of regulatory bodies to raise product minimum standards
  - Identifying and addressing other **technical** barriers to the deployment of inverter AC
  - Opening the inverter AC market to local AC companies that collectively can help drive costs downwards.
  - Catalyzing a market shift to more efficient air conditioners with minimal increased costs to help pave the way for an economically viable market.

*K-CEP grant originally for support to 3 Southeast Asian countries for technology-based approach to promote regional transformation of the RAC market*



# MODELING THE K-CEP TA ON WHAT WORKED

- Program approach modeled on the MLF Stage I HPMP - AC Sector Plan in Thailand which effectively & systematically dealt with key barriers preventing technology uptake:
  - market acceptability of R-32 refrigerant which is mildly flammable;
  - technical and human capacity to manage flammable, higher pressure gas in manufacturing;
  - regulatory hurdles for installing R-32 units in buildings; and,
  - proprietary technology
- AC Conversion to R-32 (fixed speed AC):
  - Required synchronized action on several fronts.
  - Critical mass, leadership and coordinated efforts needed to convince component suppliers to fill gap and produce R-32 compressors in larger size range.
- **Inverter AC highly competitive and technology and know-how not easily accessed by smaller companies.**



*Success of S&L programs and policies in S. East Asian countries thus far is largely attributed to the ability of governments to secure industry buy-in. But cost and technology can become limiting factors and resistance to more ambitious MEPS increases.*



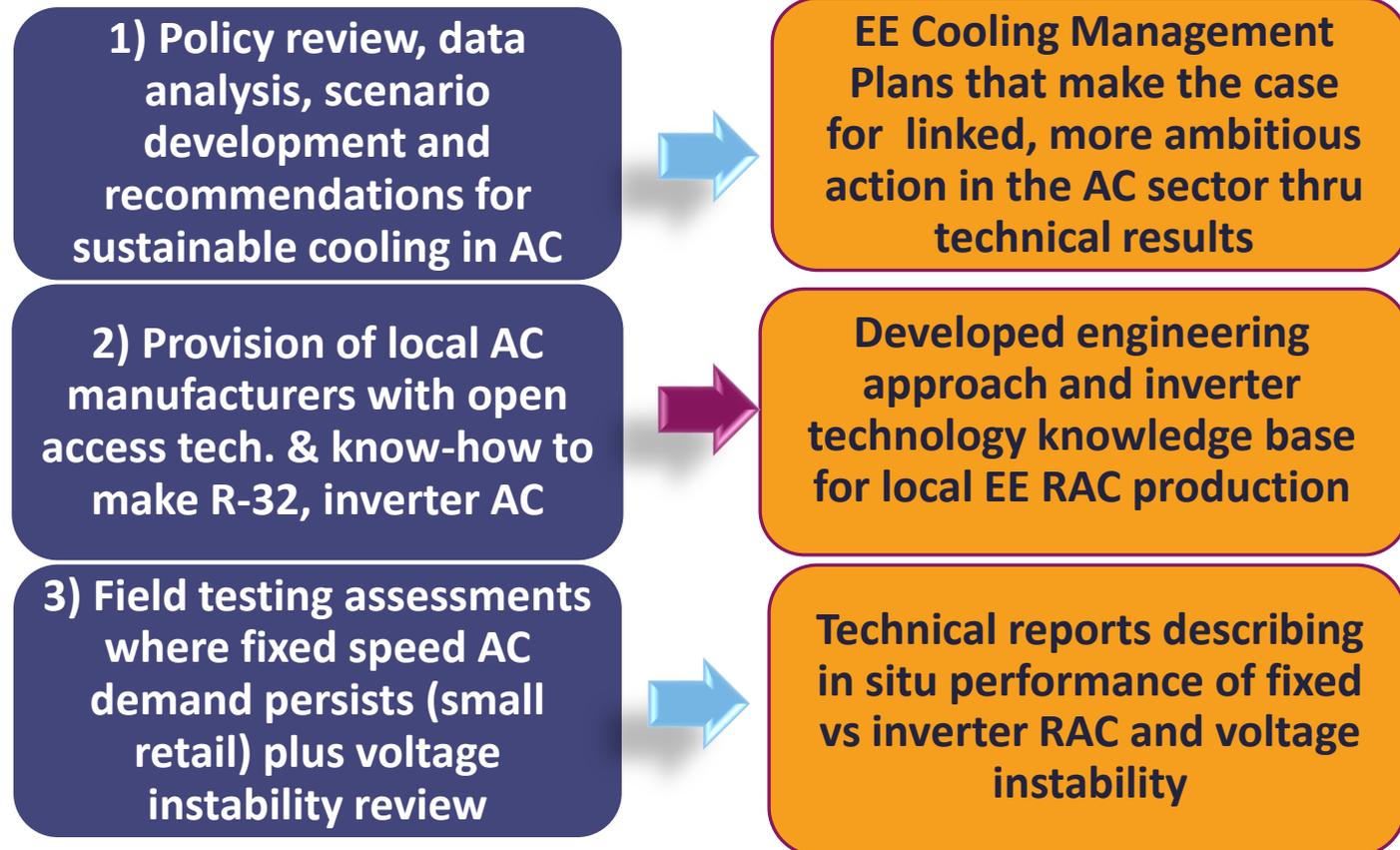
# AC MANUFACTURING READINESS PROGRAM

## Approach and Scope

**Undertaken** in cooperation with and under the guidance of the Government of Thailand (DIW, DEDE) and Government of Vietnam (DEESD, DCC).

- **Target group:** 14 RAC Thai & Vietnamese-owned AC manufacturers;
- **Product:** 1, 2, & 3 ton split AC with a focus on R-32 refrigerant in line with MLF-supported conversion projects.
- **Tech/know-how facilitator:** Leading manufacturer of hermetic compressors + research facility at Purdue University
- **Barriers addressed:** Other than access to affordable tech, also perceived inverter performance in certain applications and robustness in A5 country context
- **Policy Target:** increase ASEAN SHINE 2020 MEP target of CSPF 3.08 W/W by 20% in a timetable captured in AC cooling plan if 30% of enterprises assessed as capable to produce RAC using inverter technology and lower GWP refrigerant.

## Components and Deliverables



# RESULTS AND FINDINGS

## TECHNOLOGY SUPPORT AND FIELD ASSESSMENT

- Results significantly impacted by COVID but also vary due to capacity starting points of enterprises (engineers, testing capability, etc.) **& degree of capacity built is mixed** based on latest readiness assessments (Mar 2022)
- Results underline the key barrier remaining for room AC suppliers in offering more and higher EE room AC is **not having access to and autonomy over lower-cost inverter technology**.
- **Complexities involved in fully removing technological barriers reinforces need for an integrated sector approach that weaves in TA, market incentives, awareness raising and policy.**
- Results in relation to EE action and policy indicate that readying local AC companies for transitioning to a market of more climate-friendly AC **will be a process**, requiring additional incentives depending on needs to continue the trajectory towards harnessing the technology and know-how.
- **Mixed results of the quick studies on barriers to inverter AC field performance** across the two countries point to the need for additional research to substantiate respective assessments. Voltage impact review confirms inverter sensitivity that needs to be managed (as done by multinationals) by reliability testing protocols

## MODELING AND SCENARIO ANALYSIS

- Policy scenarios for increasing MEPS by 20% in both countries indicate that a cumulative **180 MtCO<sub>2</sub>e in direct and indirect GHG emissions savings** is possible through the Kigali compliance period of 2045.
- **Model exclusion analyses reveal the crux of the AC supply challenge where most inefficient AC products are associated with local AC firms** (manufacturers and importers).
- **Comparison of S&L programs confirm that MEPS could be better aligned with the current situation of respective markets** where the average performance rating of fixed speed models in the market is 10-22% higher.

# RESULTS AND FINDINGS

## TECHNOLOGY SUPPORT AND FIELD ASSESSMENT

- The technical knowledge-base is available to the public at large.
- Network of industry and research experts built to continue building AC enterprise capacities including with inverter manufacturers, academia and gov. research institutes.
- Enterprises' negotiating powers expected to be enhanced to obtain cost-competitive components and RAC supplies. Component costs to enterprises will be tracked.
- Enterprise capacity to integrate inverter tech and knowledge in business operations strengthened.
- As inverter technology is assimilated at beneficiary enterprises a medium-term goal could be development of business models and financing approaches for the demand-side.
- As an unconventional approach (focus on industry) towards increasing policy ambition on EE, outputs and results of open-access, inverter technology and know-how transfer to local AC manufacturers can contribute to the current dialogue on how to scale-up sustainable cooling and possible feasible models for transformative action.



**Instructional video series**

**Training Presentations**

**PID Loop Automated Software Tool**

**User Manuals for Open Access Tech**

**Inverter AC Designs & HPDM Simulation**

**AC Design Process Flowchart**

**Guide to Inverter Electronic Components**

**Assessment Survey & Field Guide**

**AC Readiness Checklist**

**Reliability Test Program & Conditions**



# THANK YOU

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