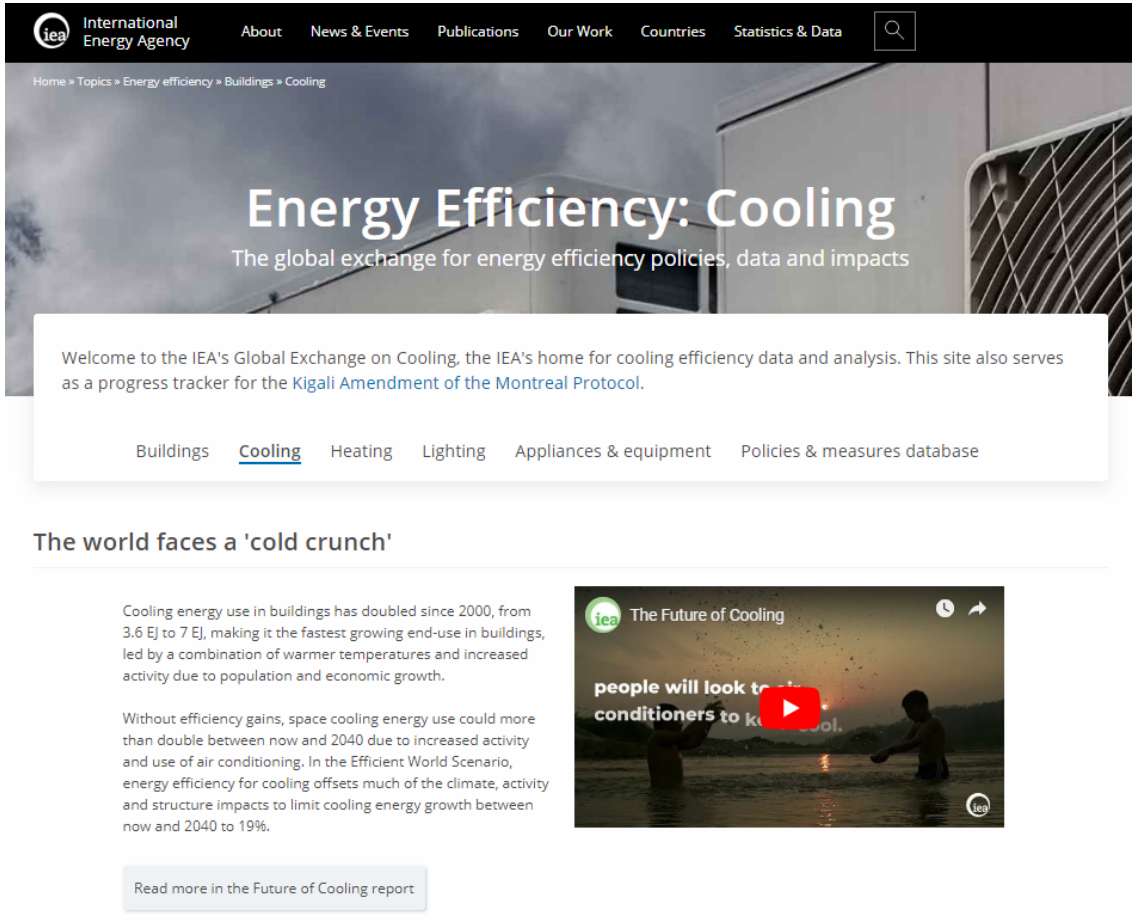
Energy Efficient Cooling

Ailin Huang, IEA E4 Programme

Beijing, 29 March 2019

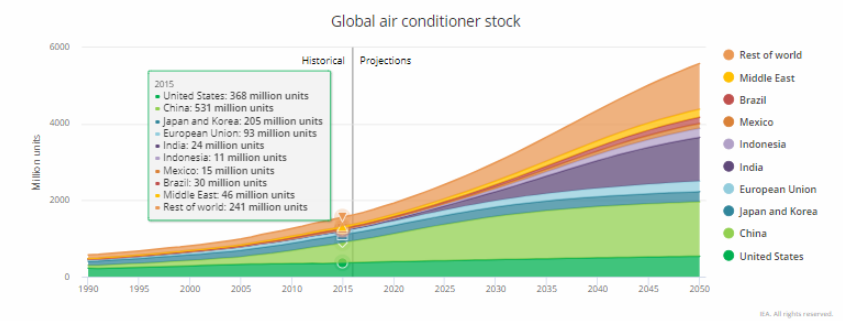
The world is getting hotter

Future of Cooling

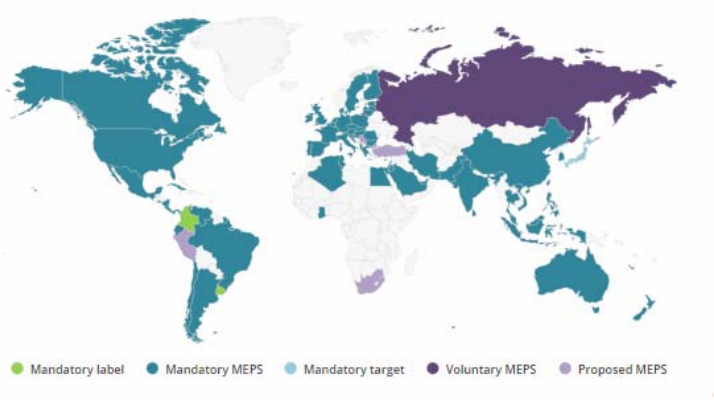


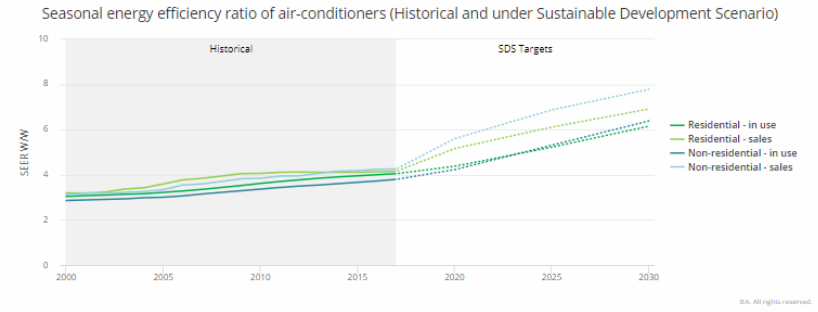
Kigali Tracker on the IEA website

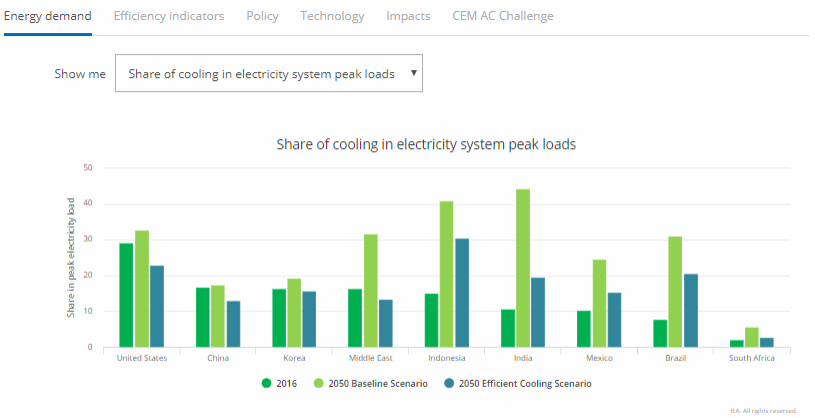
Explore the data



Download the data (Excel format)







Download the data (Excel format)

With support from

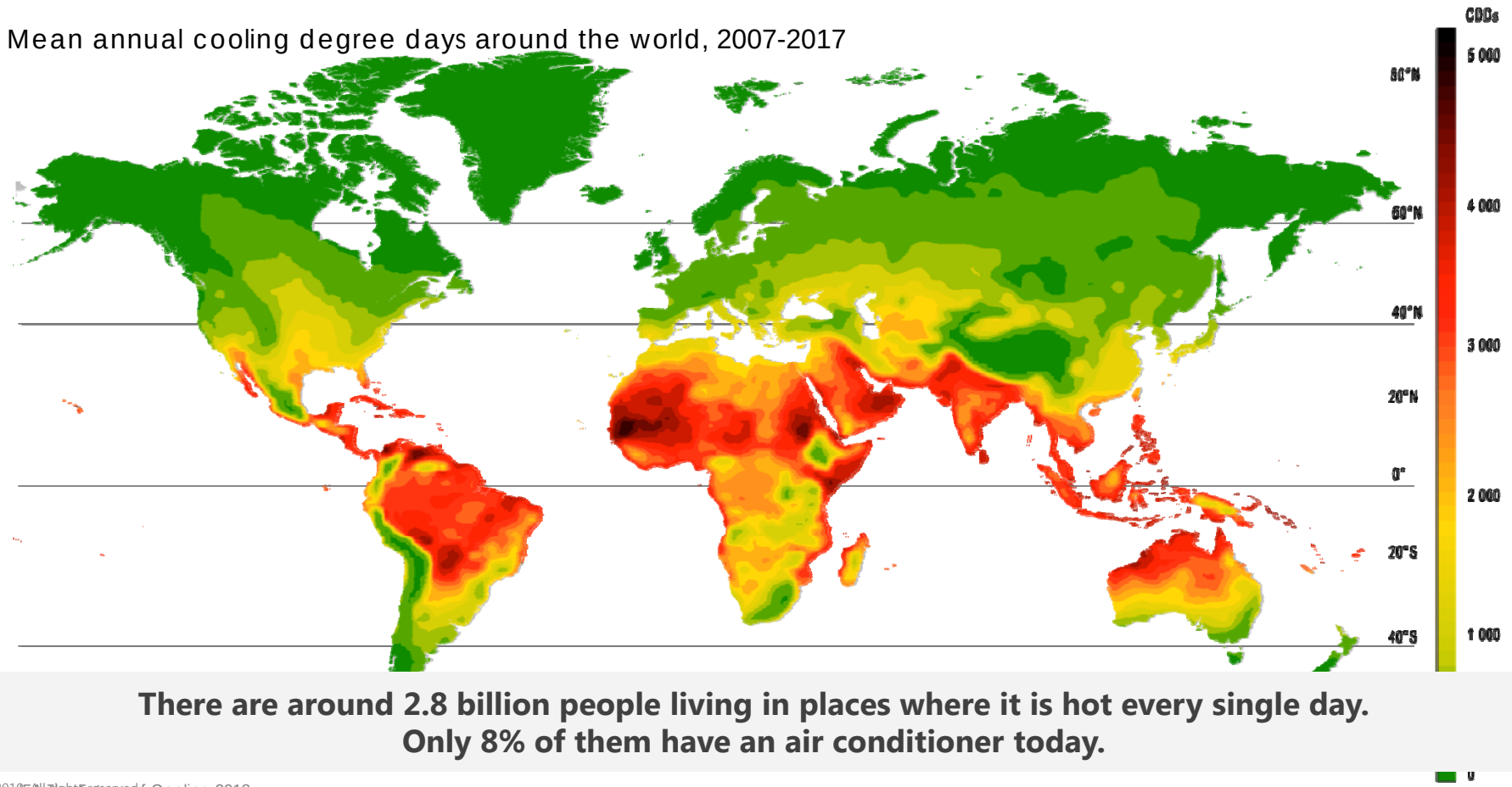
KIGALI COOLING EFFICIENCY PROGRAM

Global engagement: analysis and messaging

- The Future of Cooling report follow-on
  - The Future of Cooling: China (joint with CNIS and Tsinghua University)
  - ASEAN cooling analysis under Thailand's chairmanship of ASEAN
  - Scoping: The Future of Cooling in Personal Transport
  - Scoping: The Future of Cold Chain
- Asia Clean Energy Forum (ACEF) Thailand Edition, 2019
  - IEA is coordinating the energy efficiency agenda and will include cooling
- Training
  - Incorporate *Cooling for All* into training materials and support *Ozone Twinning* efforts
  - Increasing participation in training events (next training is in Bangkok and Paris)

Access to cooling is a critical issue in some of the hottest places

Mean annual cooling degree days around the world, 2007-2017

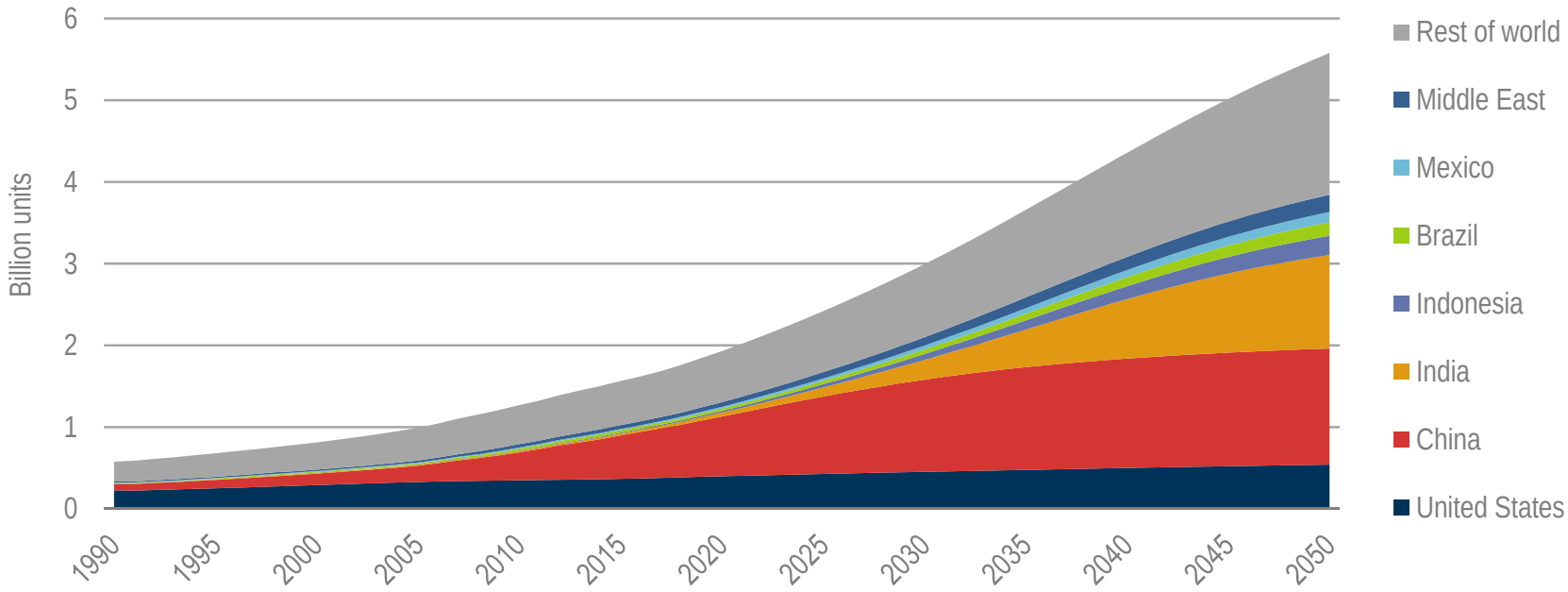


There are around 2.8 billion people living in places where it is hot every single day. Only 8% of them have an air conditioner today.

Source: IEA The Future of Cooling 2018

The world faces a ‘cold crunch’

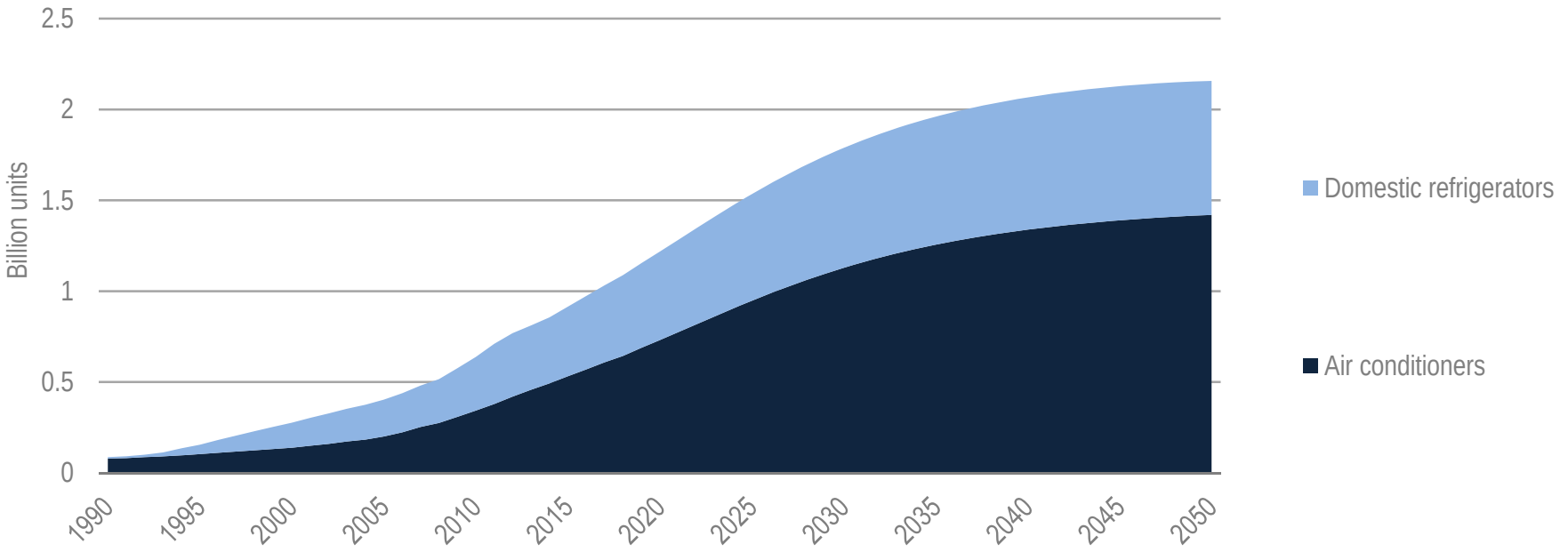
Global air conditioner stock



By 2050, around 2/3 of the world’s households could have an air conditioner. China, India and Indonesia will together account for half of the total number.

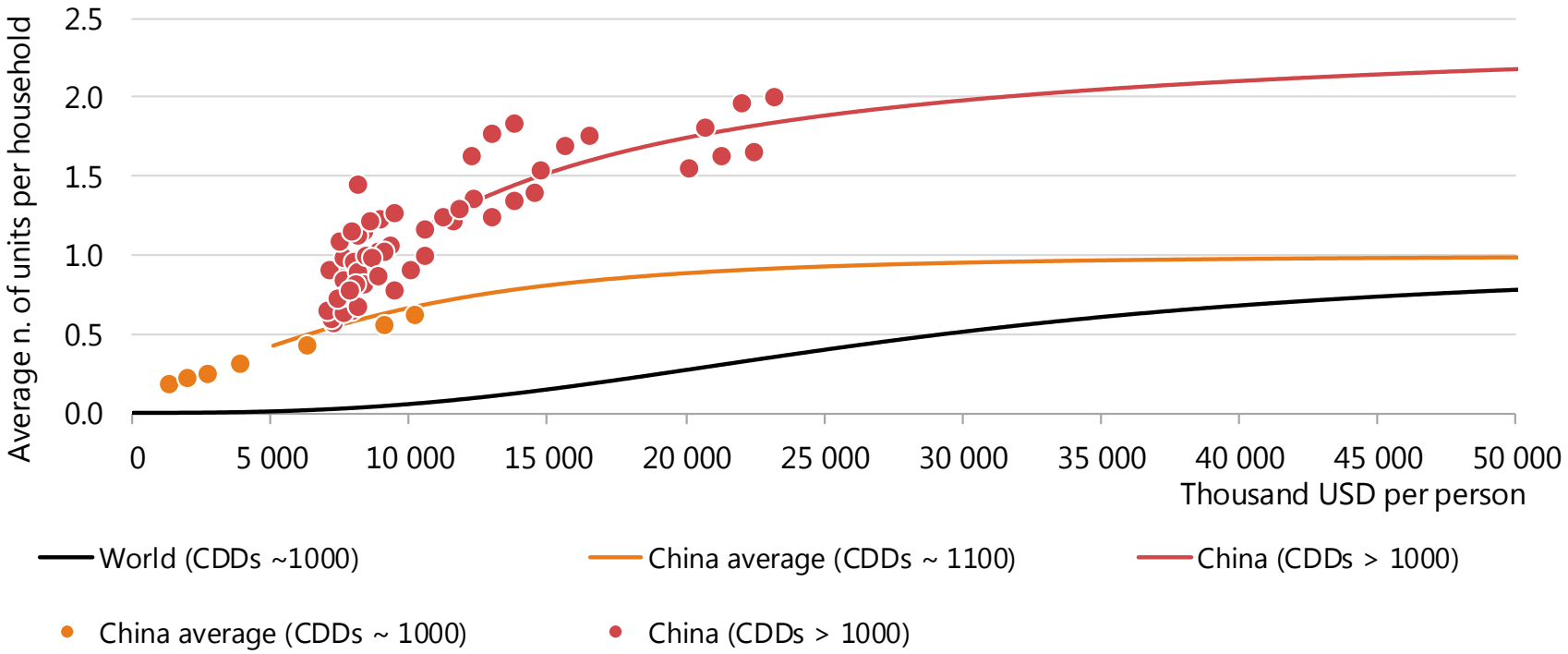
China faces a ‘cold crunch’

Air conditioner and refrigerator stock in China



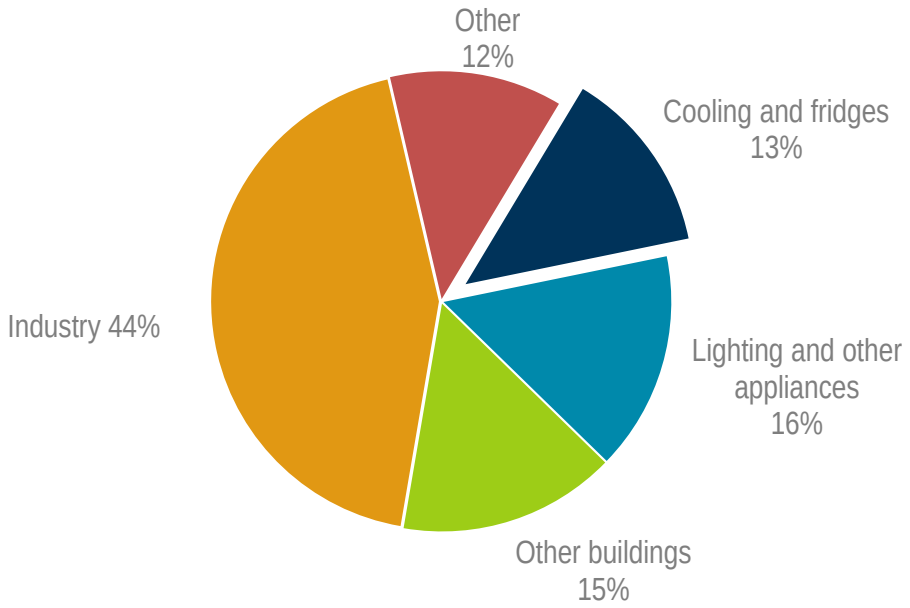
The number of air conditioners and refrigerators in China could double by 2050.

CDD in China by provinces



ACs and refrigerators will be strong drivers of electricity demand

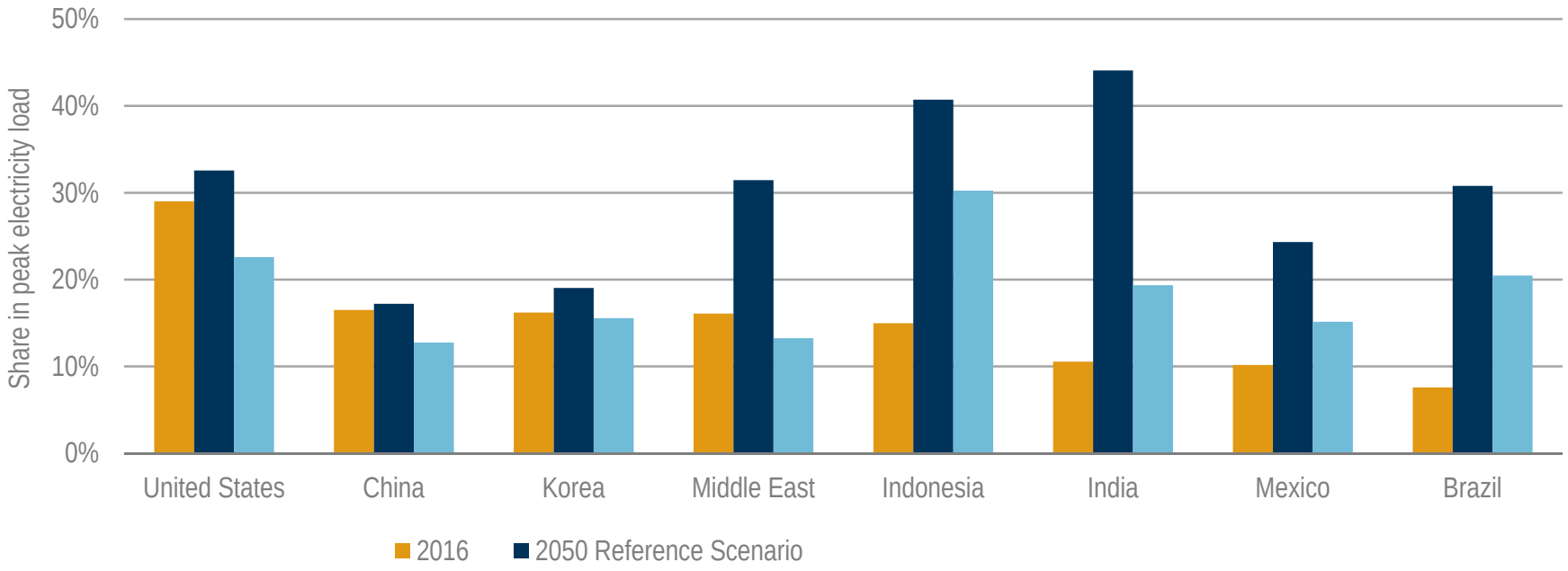
Share of final electricity demand growth to 2030 in China



Without action to address energy efficiency, cooling and domestic refrigerators will be responsible for around 13% of electricity growth in China.

Cooling demand has serious implications for grids

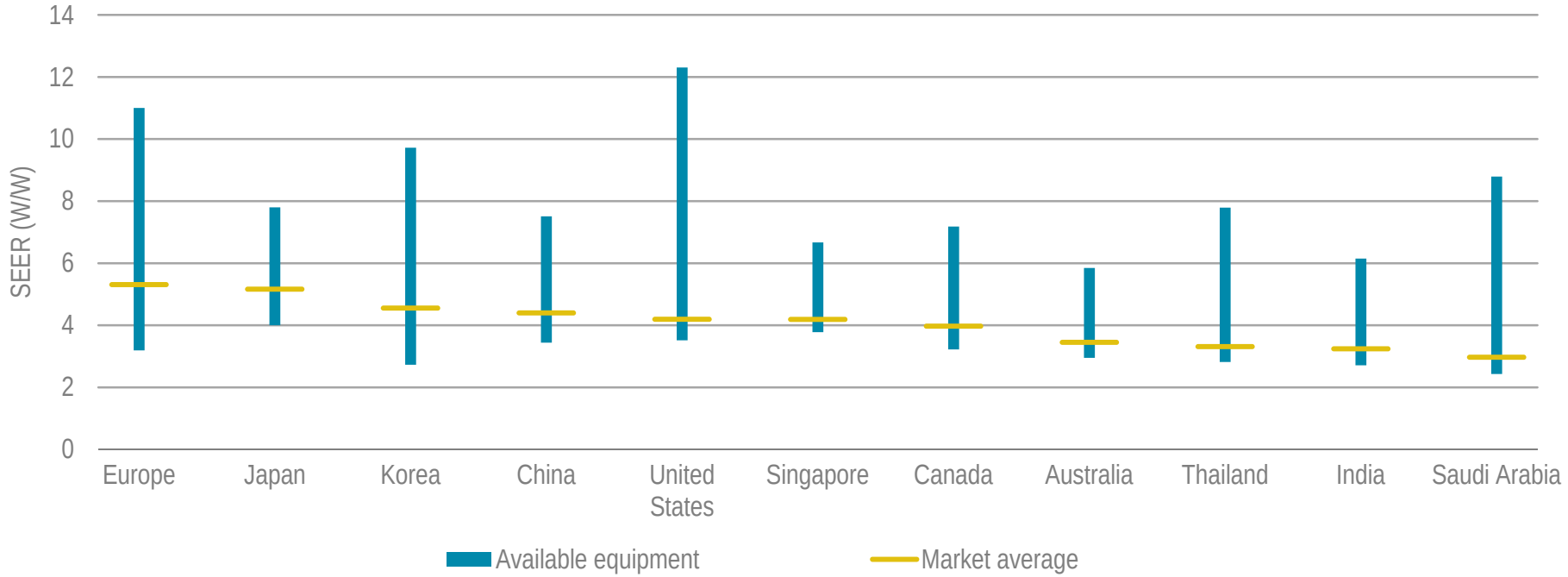
Share of cooling in electricity system peak loads



Efficient air conditioners can help to dampen the impact on the power system in China by 15% in 2030 and 25% in 2050.

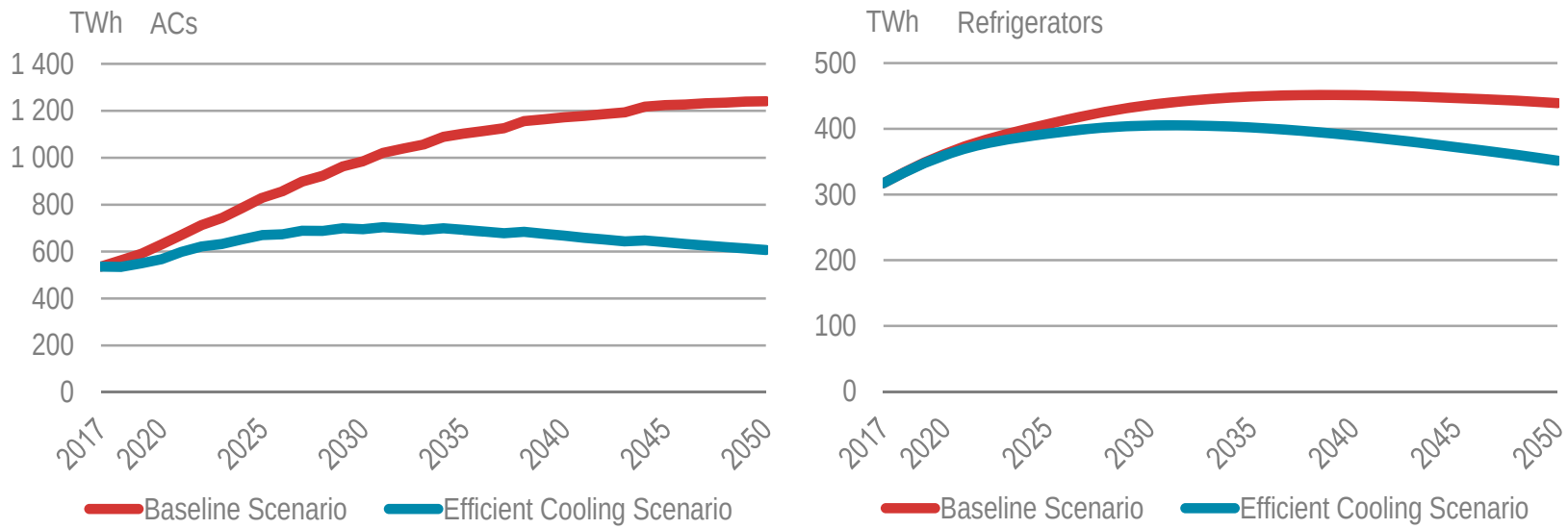
Markets are not keeping up with energy efficiency potential

Energy performance of air conditioners already available in markets today



Efficient ACs can halve cooling growth in China

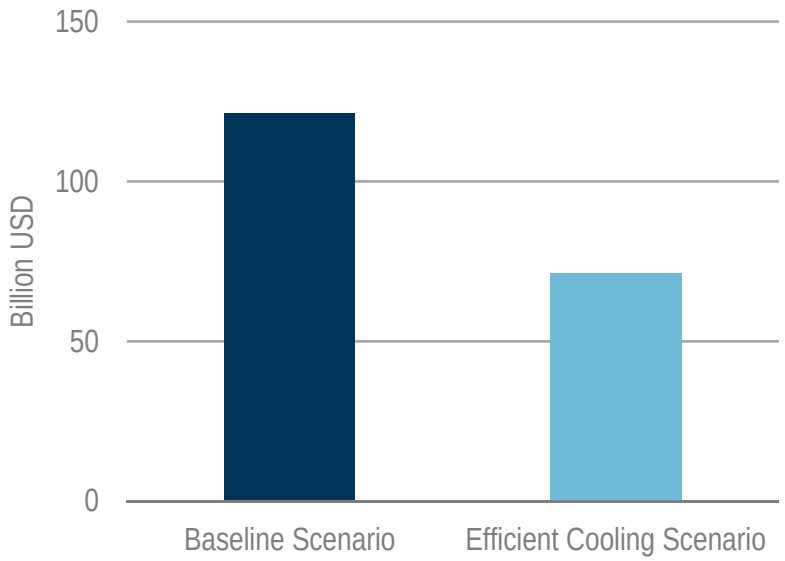
Electricity savings using energy-efficient air conditioning in India and China



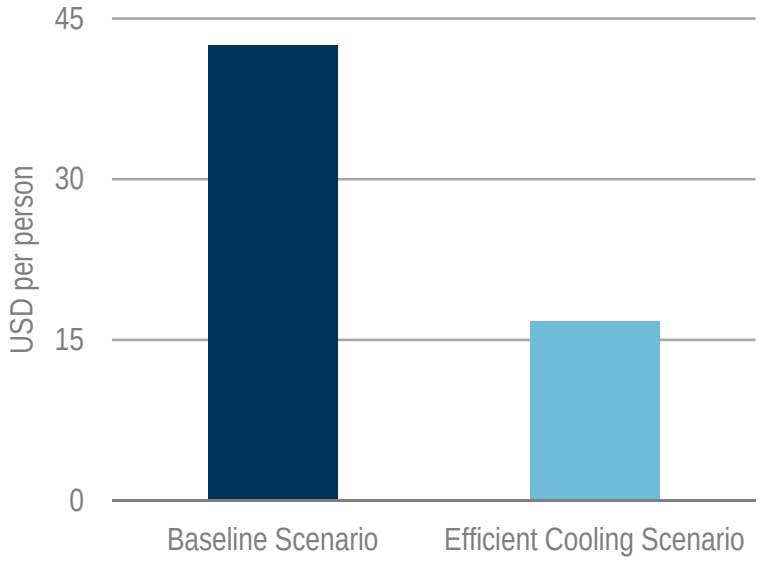
Energy-efficient ACs and fridges can deliver more than 2 000 TWh of electricity savings in China by 2030 and nearly 13 000 TWh by 2050.

Efficient ACs can lessen the costs of new power generation in China

Cumulative investments in power generation for space cooling to 2030 in China



Global average electricity costs per capita for space cooling in 2030 in China



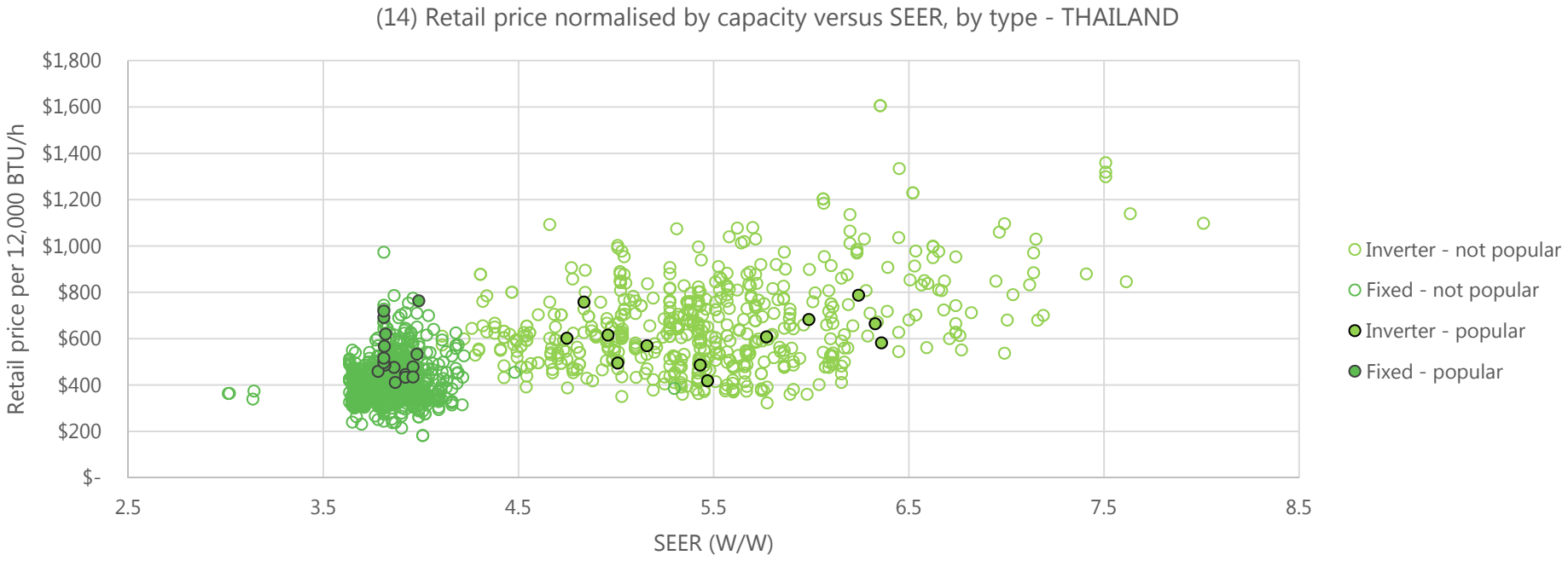
More efficient ACs can save USD 50 billion of power generation investments in China. Average per capita electricity costs for cooling would be more than halved.

Future of Cooling – China

- Trend analysis: cooling in China's building sector
- State of the market: cooling demand
  - Evolution of stock and sales of cooling equipment
- Emerging cooling trends
  - Equipment choice
  - Trends in cooling behaviour and building operations
  - Interaction between technology and behaviour
- Divers and future perspective
  - Drivers of demand (CDD climate change), life style etc.
- Outlooks on demand: potential growth scenarios
- Technology: Barriers and opportunities
- Policy opportunities

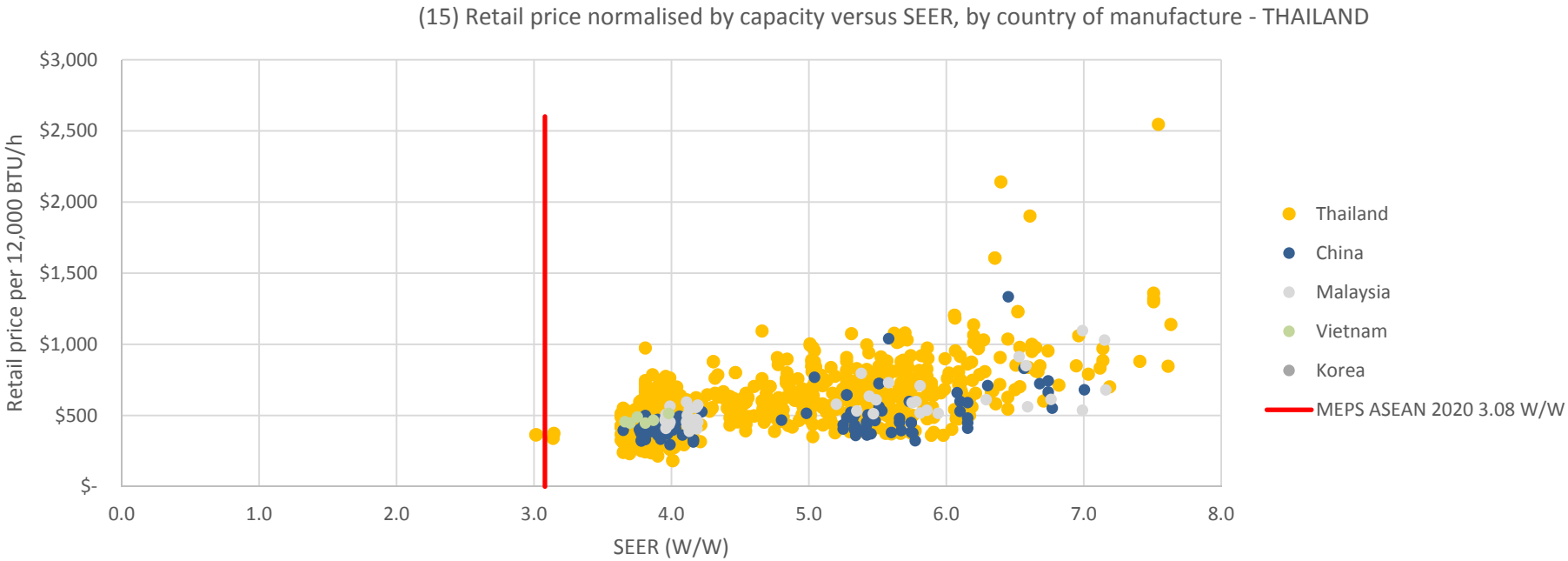
Cooling in ASEAN

Price and efficiency

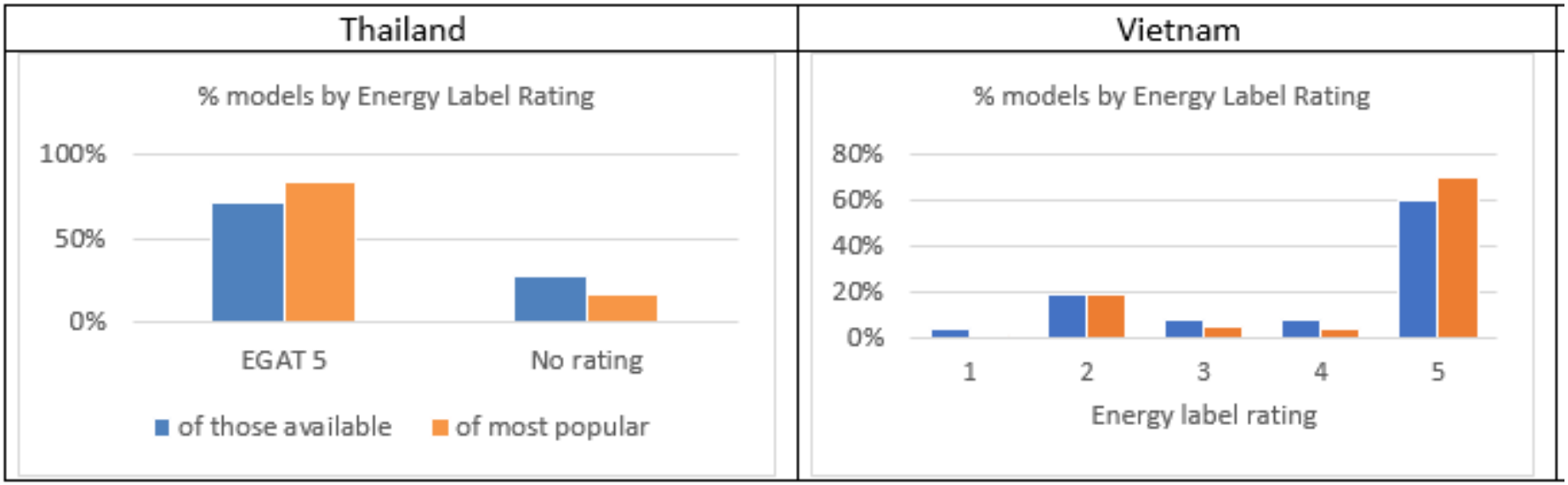


Efficiency doesn't have to come at a higher cost.

Country of manufacture



Energy rating



Most models have the label with the highest rating. This suggests a recalibration of the levels is needed to differentiate the most efficient models.

www.iea.org

Kigali Tracker

Data template

Sharing from K-CEP partners

Information:

- Welcome

Frequently used:

- Project Reporting
- Policy Reporting
- Technology Reporting

If data is available:

- Residential Stock
- Non-residential Stock

Information:

- Welcome

Frequently used:

- **Project Reporting**
- **Policy Reporting**
- Technology Reporting

If data is available:

- Residential Stock
- Non-residential Stock

Category

- Country name, category, sector, end-use, type

Project/Policy

- Name, evaluation start date

Efficiency

- Improvement impact, metric, end-use

Refrigerant

- Improvement impact, metric, end-use

Information:

- Welcome

Frequently used:

- Project Reporting
- Policy Reporting
- **Technology Reporting**

If data is available:

- Residential Stock
- Non-residential Stock

Category

- Country name, category, product type, fuel type, end-use, coverage, compressor type, collection date

Efficiency

- Improvement impact, metric, end-use, information type

Size / Capacity

- Size, metric, end-use, information type

Refrigerant

- Improvement impact, metric, end-use, information type

Sales / Count

- AC sales, refrigerant sales, refrigerant sales metric, year

Information:

- Welcome

Frequently used:

- Project Reporting
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- Technology Reporting

If data is available:

- **Residential Stock**
- **Non-residential Stock**

General data

- Cooling degree days, % floor area cooled, year

Sales

- Share of sales by year by equipment type

Stock

- Share of existing equipment by year by equipment type

Energy Efficiency

- Energy efficiency by year by equipment type

Refrigerant

- Refrigerant in use by year by equipment type

Energy

- Energy use by year by equipment type

Information:

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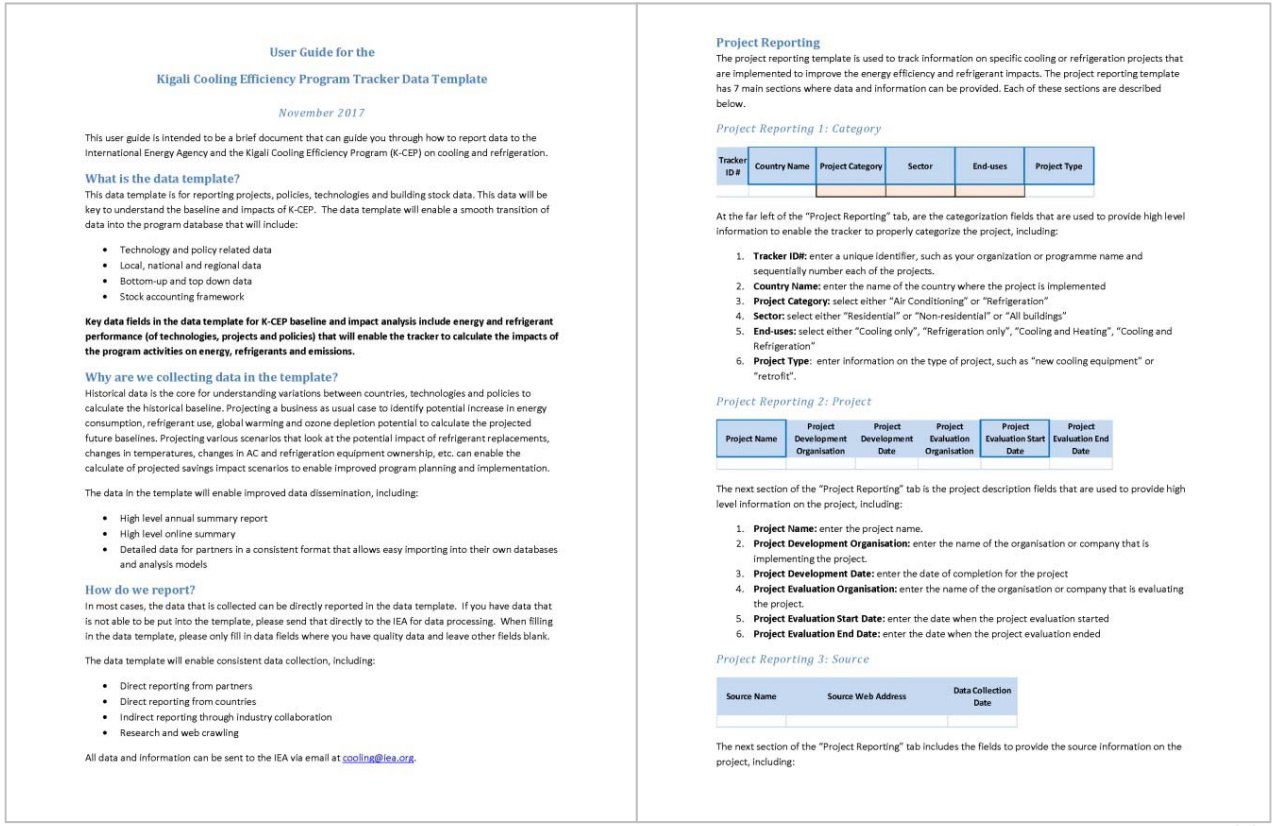

User Guide for the

Kigali Cooling Efficiency Program Tracker Data Template

November 2017

This user guide is intended to be a brief document that can guide you through how to report data to the International Energy Agency and the Kigali Cooling Efficiency Program (K-CEP) on cooling and refrigeration.

What is the data template?

This data template is for reporting projects, policies, technologies and building stock data. This data will be key to understand the baseline and impacts of K-CEP. The data template will enable a smooth transition of data into the program database that will include:

- Technology and policy related data
- Local, national and regional data
- Bottom-up and top down data
- Stock accounting framework

Key data fields in the data template for K-CEP baseline and impact analysis include energy and refrigerant performance (of technologies, projects and policies) that will enable the tracker to calculate the impacts of the program activities on energy, refrigerants and emissions.

Why are we collecting data in the template?

Historical data is the core for understanding variations between countries, technologies and policies to calculate the historical baseline. Projecting a business as usual case to identify potential increase in energy consumption, refrigerant use, global warming and ozone depletion potential to calculate the projected future baselines. Projecting various scenarios that look at the potential impact of refrigerant replacements, changes in temperatures, changes in AC and refrigeration equipment ownership, etc. can enable the calculate of projected savings impact scenarios to enable improved program planning and implementation.

The data in the template will enable improved data dissemination, including:

- High level annual summary report
- High level online summary
- Detailed data for partners in a consistent format that allows easy importing into their own databases and analysis models

How do we report?

In most cases, the data that is collected can be directly reported in the data template. If you have data that is not able to be put into the template, please send that directly to the IEA for data processing. When filling in the data template, please only fill in data fields where you have quality data and leave other fields blank.

The data template will enable consistent data collection, including:

- Direct reporting from partners
- Direct reporting from countries
- Indirect reporting through industry collaboration
- Research and web crawling

All data and information can be sent to the IEA via email at cooling@iea.org.

Project Reporting

The project reporting template is used to track information on specific cooling or refrigeration projects that are implemented to improve the energy efficiency and refrigerant impacts. The project reporting template has 7 main sections where data and information can be provided. Each of these sections are described below.

Project Reporting 1: Category

Tracker ID #	Country Name	Project Category	Sector	End-uses	Project Type

At the far left of the "Project Reporting" tab, are the categorization fields that are used to provide high level information to enable the tracker to properly categorize the project, including:

1. **Tracker ID#:** enter a unique identifier, such as your organization or programme name and sequentially number each of the projects.
2. **Country Name:** enter the name of the country where the project is implemented
3. **Project Category:** select either "Air Conditioning" or "Refrigeration"
4. **Sector:** select either "Residential" or "Non-residential" or "All buildings"
5. **End-uses:** select either "Cooling only", "Refrigeration only", "Cooling and Heating", "Cooling and Refrigeration"
6. **Project Type:** enter information on the type of project, such as "new cooling equipment" or "retrofit".

Project Reporting 2: Project

Project Name	Project Development Organisation	Project Development Date	Project Evaluation Organisation	Project Evaluation Start Date	Project Evaluation End Date

The next section of the "Project Reporting" tab is the project description fields that are used to provide high level information on the project, including:

1. **Project Name:** enter the project name.
2. **Project Development Organisation:** enter the name of the organisation or company that is implementing the project.
3. **Project Development Date:** enter the date of completion for the project
4. **Project Evaluation Organisation:** enter the name of the organisation or company that is evaluating the project.
5. **Project Evaluation Start Date:** enter the date when the project evaluation started
6. **Project Evaluation End Date:** enter the date when the project evaluation ended

Project Reporting 3: Source

Source Name	Source Web Address	Data Collection Date

The next section of the "Project Reporting" tab includes the fields to provide the source information on the project, including:

Information:

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Project Reporting 5: Efficiency

Efficiency Baseline	Efficiency Upgrade	Efficiency Metric	Efficiency Improvement End-use

The next section of the "Project Reporting" tab includes the fields to provide the efficiency information on the project. This section enables reporting on multiple types of efficiency impacts, such that you can include information on peak energy (EER) or seasonal energy efficiency (SEER) or other known metrics. The section has four main information types, including:

1. **Efficiency Baseline:** enter the value for the efficiency baseline. Such that for a project that is changing an air conditioner from a baseline of 13 SEER to 18 SEER, please enter "13" for a 13 SEER baseline equipment.
2. **Efficiency Upgrade:** enter the value for the efficiency upgrade. Such that for a project that is changing an air conditioner from a baseline of 13 SEER to 18 SEER, please enter "18" for an 18 SEER upgrade equipment.
3. **Efficiency Metric:** enter the metric used to characterize the efficiency, such as "SEER" or "COP".
4. **Efficiency Improvement End-use:** select either "Space Cooling", "Space Heating", "Water heating", or "Refrigeration".

Information:

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Project Reporting 6: Refrigerant

Refrigerant Baseline	Refrigerant Upgrade	Refrigerant Metric	Refrigerant Improvement End-use

The next section of the "Project Reporting" tab includes the fields to provide the refrigerant information on the project. The section has four main information types, including:

1. **Refrigerant Baseline:** enter the value for the refrigerant baseline. Such that for a project that is changing an air conditioner from a baseline of 1690 GWP to 120 GWP, please enter "1690" for the baseline value.
2. **Refrigerant Upgrade:** enter the value for the refrigerant baseline. Such that for a project that is changing an air conditioner from a baseline of 1690 GWP to 120 GWP, please enter "120" for the upgrade value.
3. **Refrigerant Metric:** enter the metric used to characterize the refrigerant improvement, such as "GWP" or "%".
4. **Refrigerant Improvement End-use:** select either "Space Cooling", "Space Heating", "Water heating", or "Refrigeration".

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Technology Reporting 3: Efficiency (cooling mode)

Product Efficiency	Product Efficiency Metric	Efficiency Information Type	System Size (Cooling Delivered)	Size Metric	Rated Input Power (kW) for cooling	Calculated COP (W/W) Cooling mode	Calculated EER (BTU/Wh) Cooling mode

The next section includes efficiency information on the cooling mode of the product, including:

1. **Product Efficiency:** enter the value for the product efficiency. Such that for an 18 SEER air conditioner please enter “18”.
2. **Product Efficiency Metric:** enter the metric used to characterize the product efficiency. Such that for an 18 SEER air conditioner please enter “SEER”. Field includes the selection of “COP (W/W)”, “SCOP (W/W)”, “EER (BTU/Wh)”, “SEER (BTU/Wh)”, “iSEER (BTU/Wh)”, “HSPF (BTU/Wh)”, “kWh/year” or “Other (specify)”.
3. **Efficiency Information Type:** indicate whether the information source is “Certified” information or “Advertised” information.
4. **System Size:** indicate the amount of cooling delivered in either “kW”, “BTU/h” or “ton (12000 BTU/h)”
5. **Size Metric:** indicate the metric used for the amount of cooling delivered in either “kW”, “BTU/h” or “ton (12000 BTU/h)”
6. **Rated Input Power (kW) for cooling:** enter the rated power for the cooling mode of the product.
7. **Calculated COP and EER:** both of these fields will automatically calculate the COP and EER based on the system size and rated power data fields.

Information:

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Frequently used:

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If data is available:

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Technology Reporting 7: Refrigerant

Refrigerant Type	Refrigerant Charge	Refrigerant Charge Metric	Annual Leakage Rate (%)	Global Warming Potential	Ozone Depletion Potential	Refrigerant Information Type

The next section includes information on the refrigerant used in the product, including:

1. **Refrigerant Type:** enter the name for the type of refrigerant used in the product.
2. **Refrigerant Charge:** enter the amount of refrigerant used in the product when in operation.
3. **Refrigerant Charge Metric:** indicate the metric used to specify the refrigerant charge, such as "kg/unit" or "lbs/unit".
4. **Annual Leakage Rate:** specify the estimate annual leakage rate for the product.
5. **Global Warming Potential:** specify the global warming potential for the refrigerant type used in the product.
6. **Ozone Depletion Potential:** specify the ozone depletion potential for the refrigerant type used in the product.
7. **Refrigerant Information Type:** indicate whether the information source is "Certified" information or "Advertised" information.

Kigali Tracker to date

IEA has received data for:

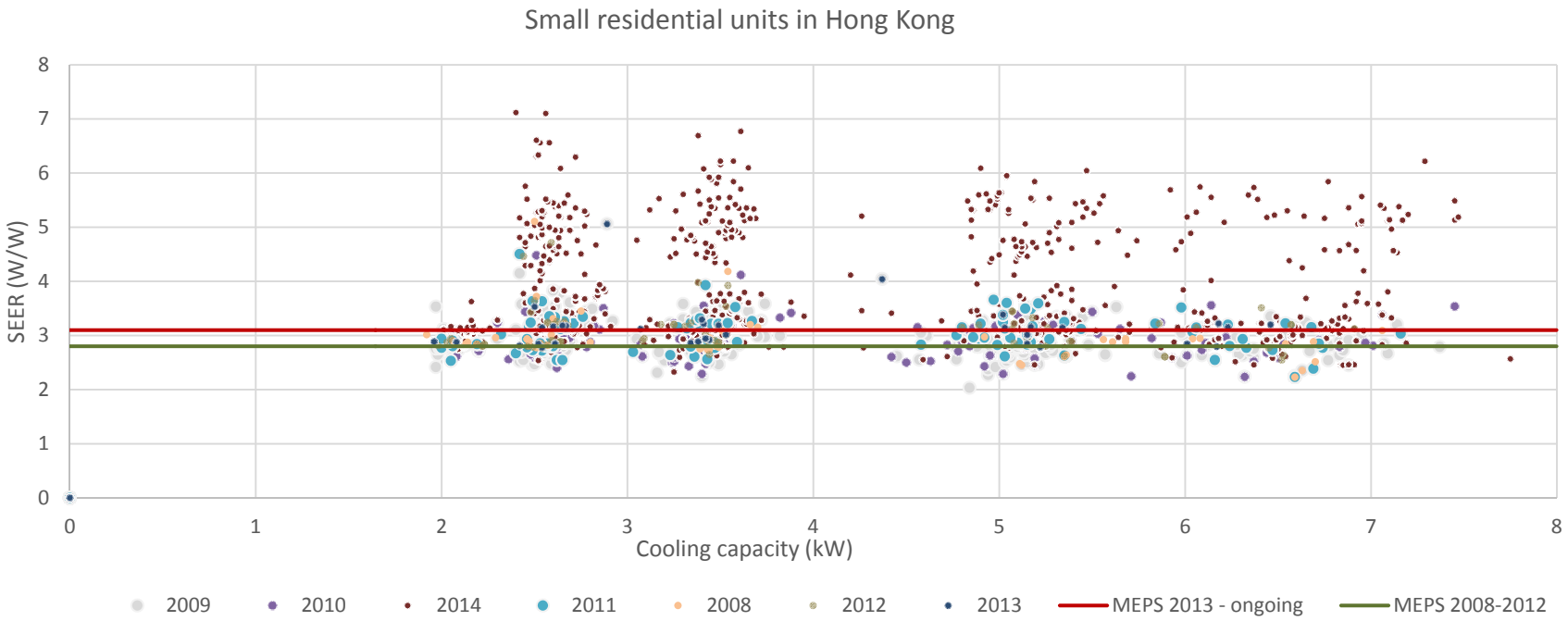
- Brazil (iCS)
  - Technology reporting for almost 3,000 ACs
  - Policies reporting (MEPS, label, procurement)
  - K-CEP project reporting
- Vietnam/Philippines/Thailand (CLASP)
  - Technology reporting for over 7,000 ACs
  - Some AC manufacturing/import/export data
  - Some energy market data

What do you have available?

Extra slides

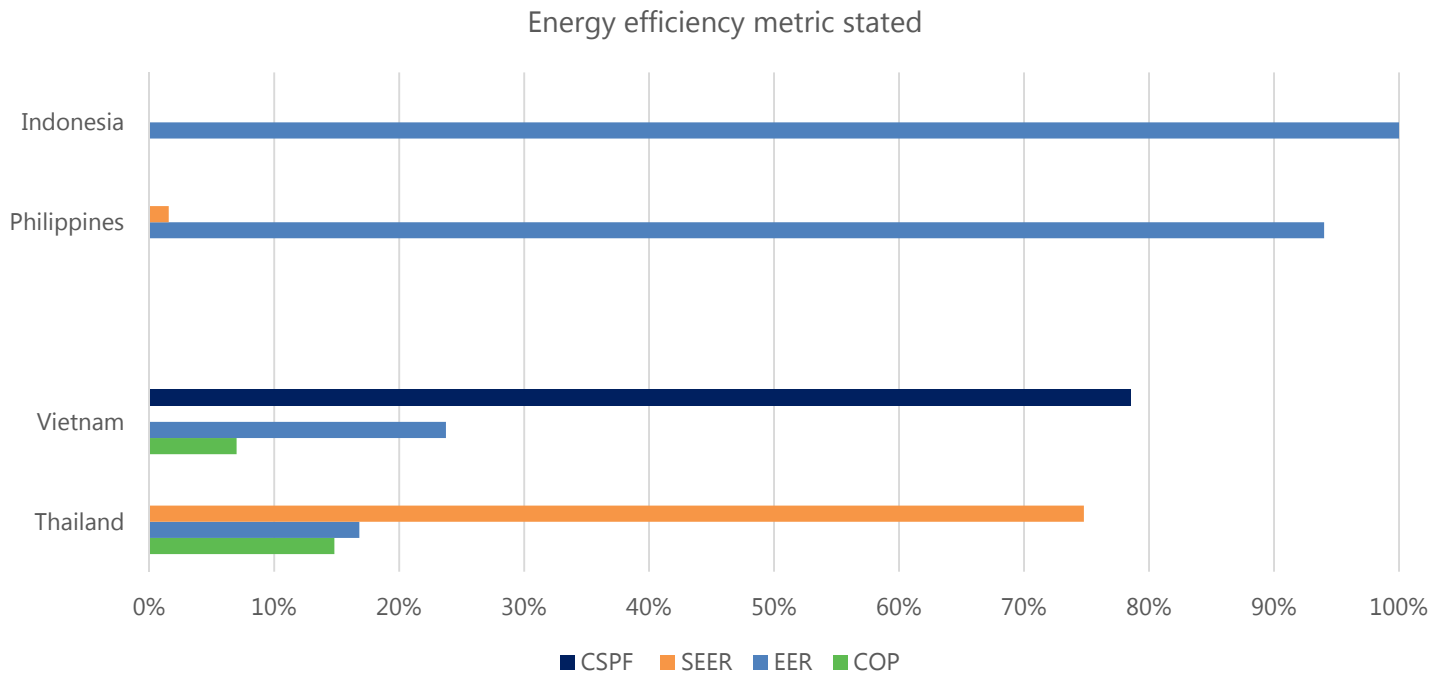
Markets are not keeping up with energy efficiency potential

Energy performance of air conditioners in Hong Kong



Example of using market data for improving the case for higher MEPS in China.

Energy Efficiency metric used



There is significant discrepancy in the energy efficiency information available to customers across the different countries.