Environmentally Cooling Strategic Options

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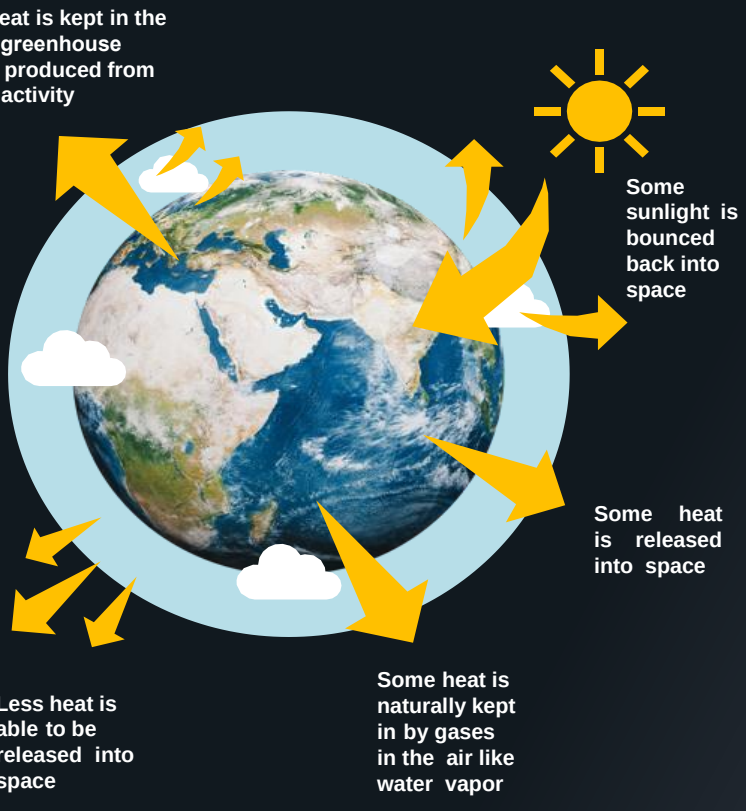
Climate Change and Global Warming



Climate Change is a growing issue around the world

Mainly caused by Global Warming

Global Warming is largely influenced by man-made GHG Emissions

CO_2 (Carbon Dioxide), CH_4 (Methane), N_2O (Nitrous Oxide), HFCs (Hydrofluorocarbons), PFCs (Perfluorocarbons) SF_6 (Sulphur hexafluoride) NF_3 (Nitrogen trifluoride)

GHG are mostly unregulated in developing countries such as Middle East

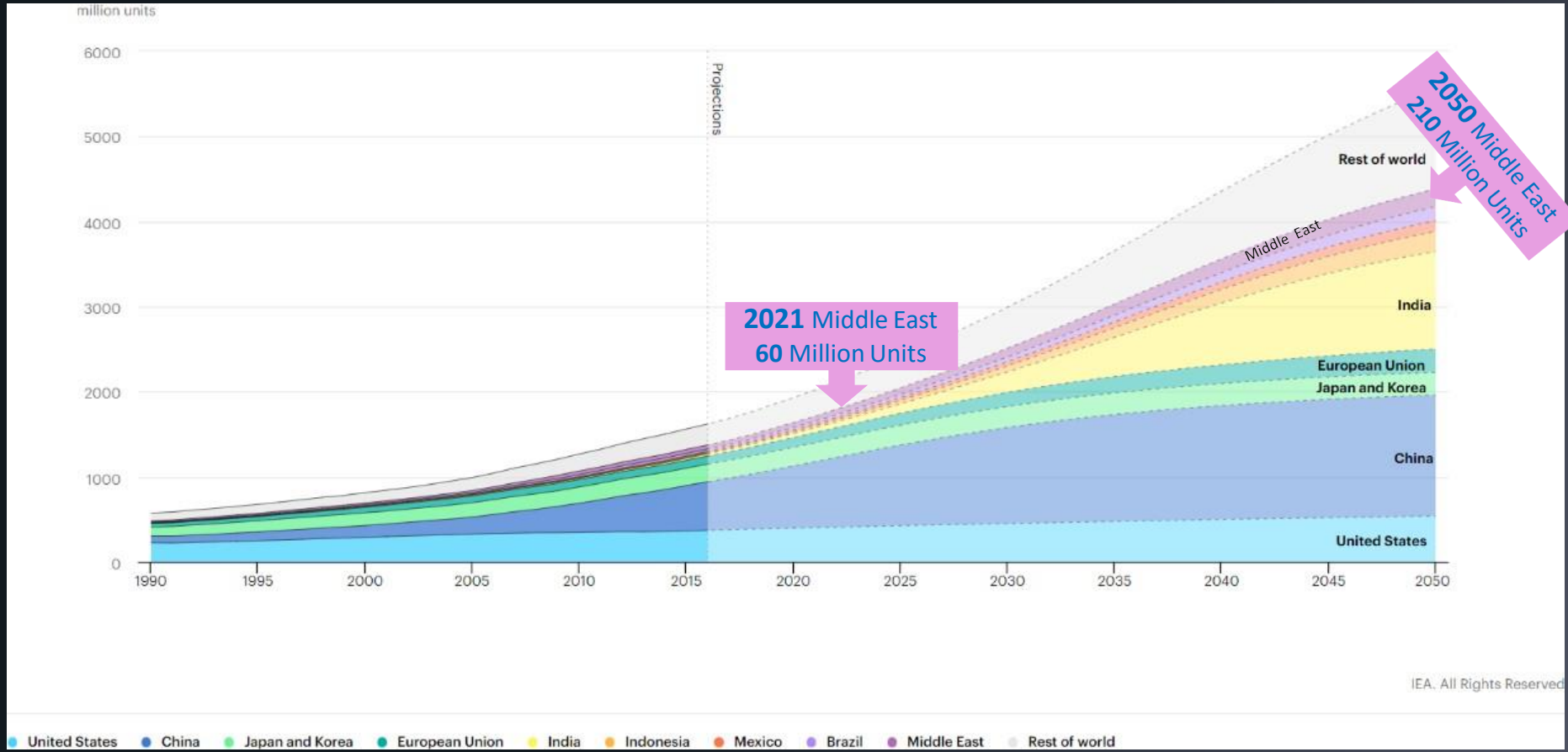
The world wants Air-condition that could warm the world

The number of air-conditioners worldwide is predicted to Rise from 1.6 billion units today to 5.6 billion units by 2050. 2020 International Energy Agency (eia) report

by 2050 air-conditioners would use as much electricity as China does for all activities today
from 1.25 billion tons in 2016 to 2.28 billion tons in 2050 Greenhouse gas emissions released when generating electricity to power those air-conditioners.

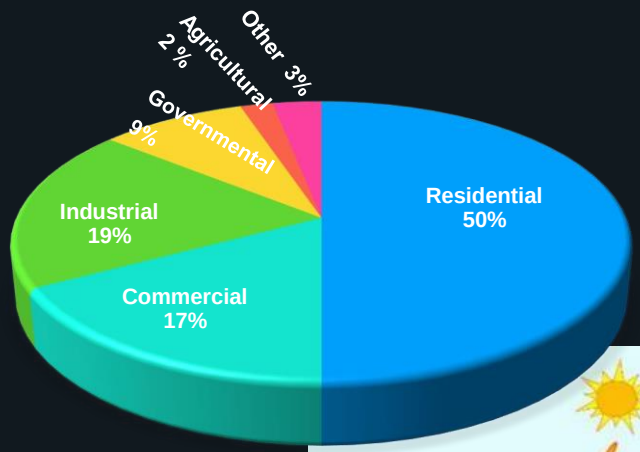
Those emissions would contribute to global warming, which could further increase the demand for air-conditioning.

Global air conditioner stock, 1990-2050

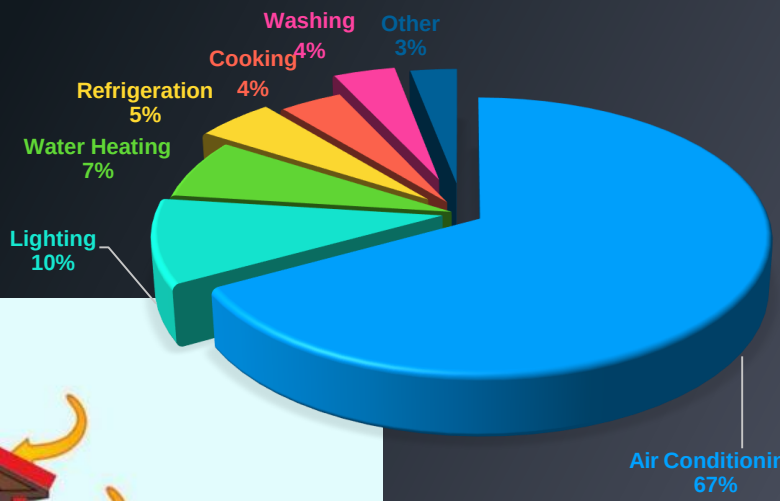


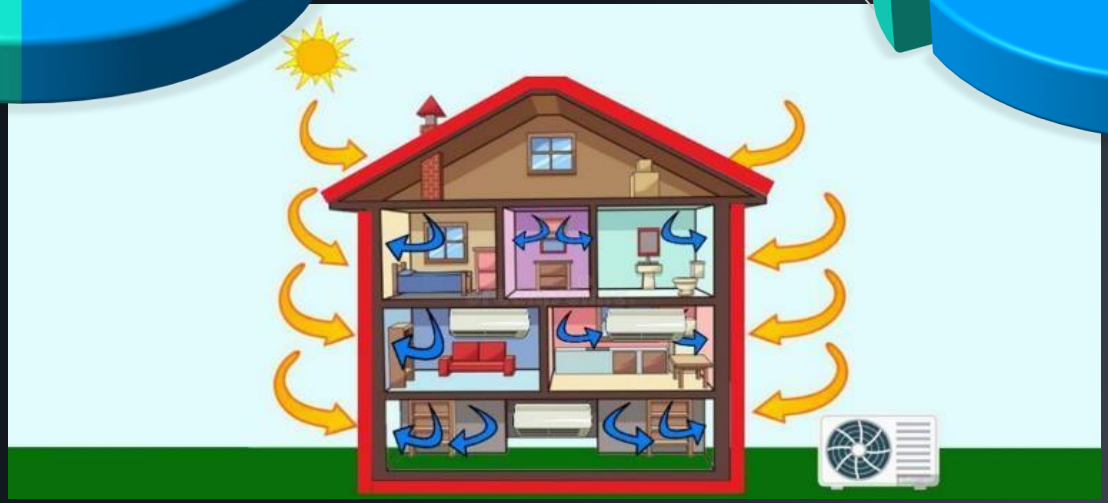
Electric Energy Consumption and HVAC Share

ELECTRICITY CONSUMPTION GCC



ELECTRIC USAGE - TYPICAL VILLA - GCC





Kuwait Prospective

It is not the strongest of the species that survives, not the most intelligent that survives. It is the one that is the most adaptable to change.

CHARLES DARWIN

How We Will Determine The Next Generation Of Refrigerant

Characteristic that Manufactures Consider:

- Performance- Efficiency and Capacity
- No Ozone Depleting Potential (ODP)
- Lowest Global Warming Potential (GWP) Practical
- Can be safely applied
- Affordable for end-users
- Available

Significant Potential to Improve Efficiency

MINIMIZING COOLING LOAD (30–60%)

Building design

Shading

Insulation

Doors on retail displays

EQUIPMENT AND CONTROL (30–70%)

High efficiency heat exchangers

High efficiency compressors

Optimized refrigeration cycle

Good controls (e.g. variable speed drives)

OPERATION AND SERVICING (15–30%)

Managing existing stock

Timely servicing

Performance measurement / fault diagnosis

REFRIGERANT SELECTION (5–10%)

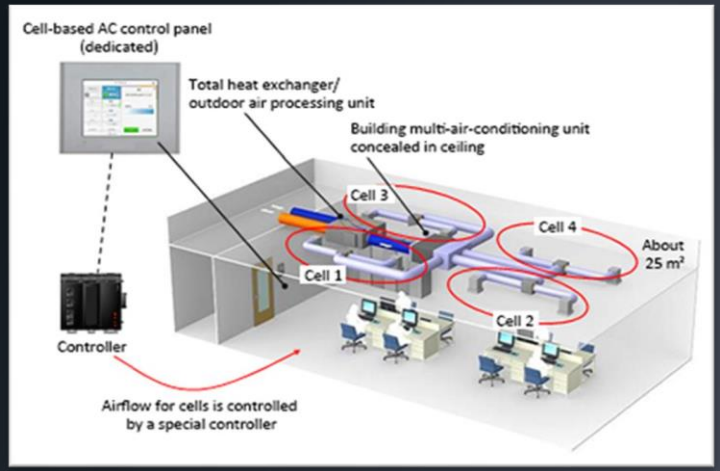
Choice of most appropriate refrigerant

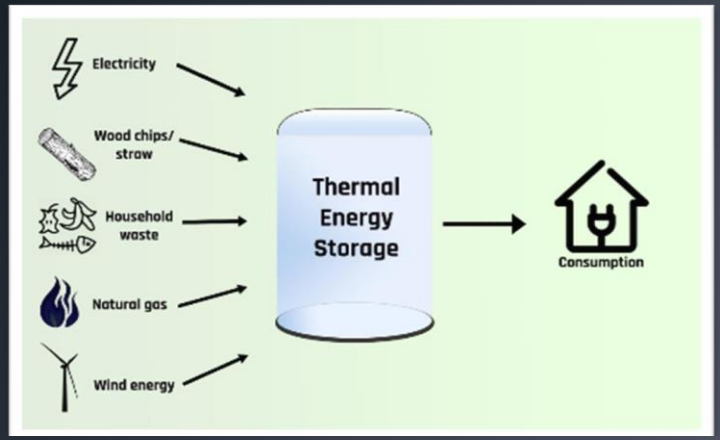
Future technologies and innovations

Automation:

- Advanced control systems
- Smart thermostat and air conditioning: The IoT
- Motion-activated air conditioning

- Thermally Driven AC
- Ice-Powered Air Conditioning
- Thermal energy storage
- Personalized or focused Air Conditioning:
- Solar-Powered Air Conditioning





Why DC is an option

- Maturity of the technology
- Renewable energy can be easily employed (variety of refrigeration cycles, such as VCRC and ARC).
- Sound technology for utilizing:
- toxic refrigerants.
- flammable refrigerants.
- Higher potential for optimization of:
- Energy efficiency (e.g., network diversity, chillers operating at optimal conditions, and thermal storage)
- System performance. (e.g., availability of prompt and large thermal capacity)

Implementation related concerns

- Cost (initial and running cost)
- Durability: longevity of district cooling components compared to conventional AC systems.
- Reliability: capability to provide the required cooling capacity at sever condition.
- Serviceability: the repair period in case of malfunctions.
- Expandability: cost of more cooling due to building expansion, and the ease of system (e.g. plant and piping network) capacity improvement.

More concerns

- Technical support: the professionalism of the DC operators and technicians.
- Validity of design: sizing, selection, integration of the DC components with the buildings they will serve.
- Monopoly of DC service.
- can the end user select/change between different providers of DC.
- How and who will control the cost of DC service.


Questions