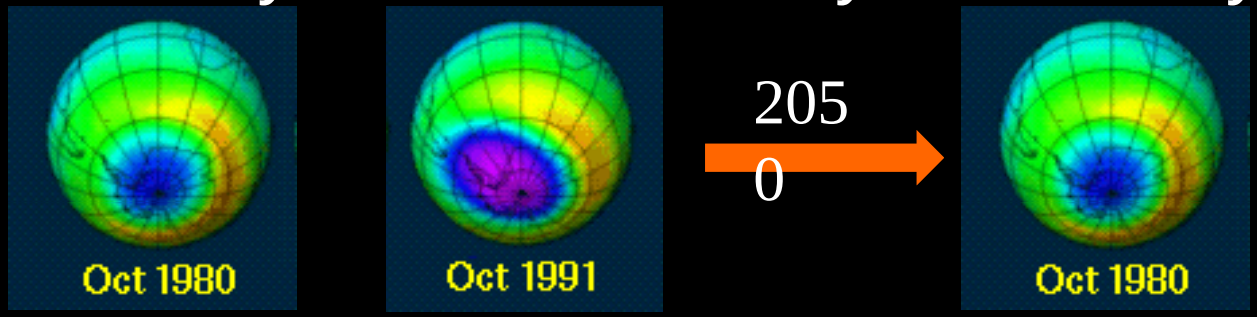
THE CASE OF HFCS

SEGMENTATION

1. Montreal Protocol
   - History, Success, Framework, Past Phase-outs
   - Synthesizing The Debate of Ozone & Climate
2. Growing Importance of HFCs
3. International Momentum
   - Amendments
   - The Gas Game
4. Phasing Down HFCs
   - Challenges-Technological and Financial
   - Opportunities- Co-benefits and Leapfrogging
5. Summary & Conclusion

Montreal Protocol

- Discovery- by British Antarctic Survey
- Vienna Convention for The Protection of Ozone Layer
  - Montreal Protocol on Substances That Deplete The Ozone Layer
  - Ozone Layer now on its way to recovery



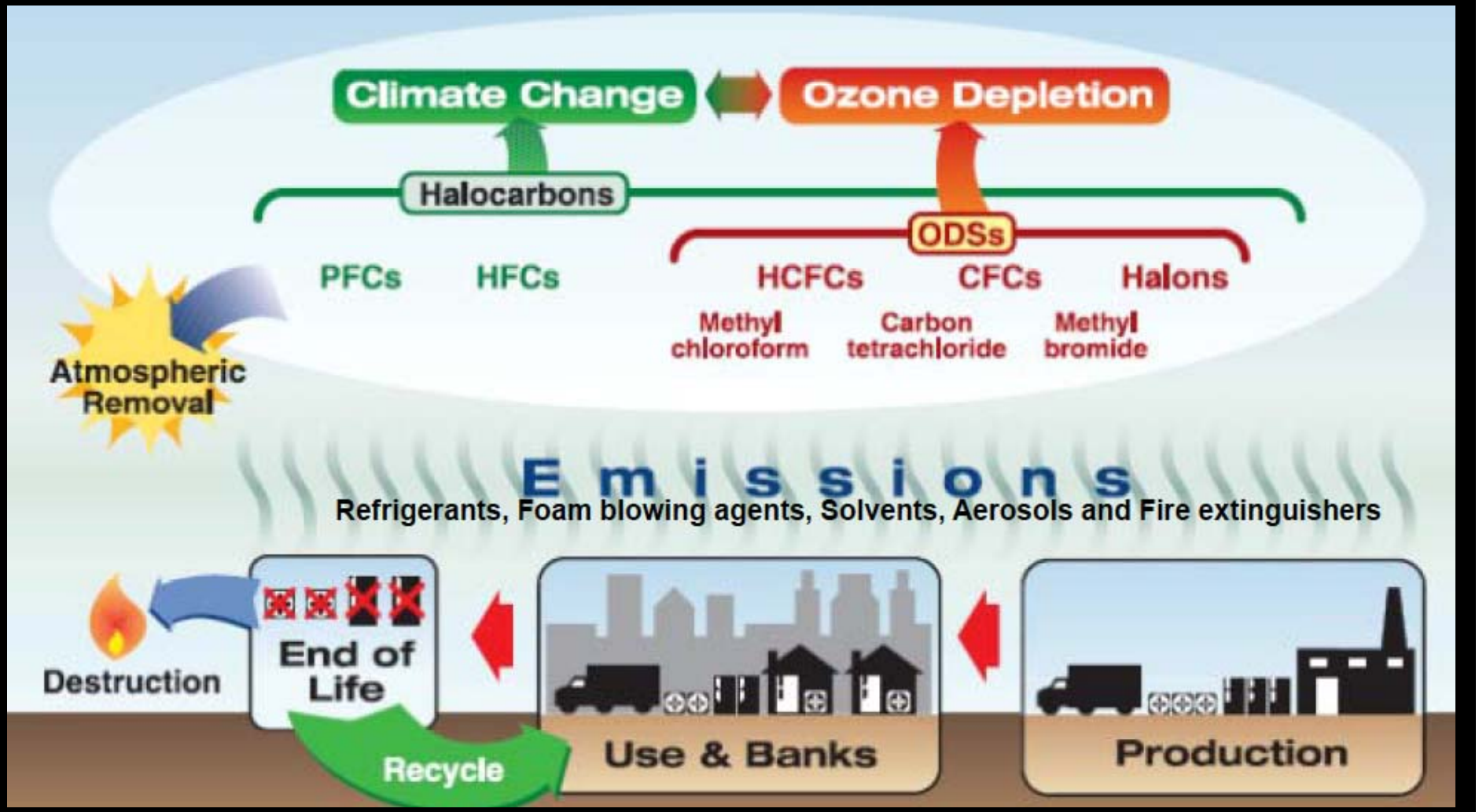
- Framework
  - Division between Article 2 and Article 5 countries
  - Common But Differentiated Responsibility
  - Exercised precautionary principle
  - Phase out steps with grace period
  - Polluter Pays- Financial Mechanism (MLF and ExCom),technology transfer
  - Expertise of SAP and TEAP
  - Decisions by Meeting of Parties

- Money provided by MLF which is governed by ExCom.
- At the national level- National Ozone Unit (NOU) deals with phase out activities
- Implementing Agencies (IAs)
- MLF- USD 3 billion- 140+ countries

- The phase-out takes place in the production and consumption
- Consumption = (Production+imports) – Exports
- Method- ODP weighted, determination of baseline, freeze, reduction steps, reduction target
- 2 set of alternatives found: Chlorinated- HCFCs and Fluorinated HFCs

- Reasons for success
  - Legally binding controls
  - Universal ratification
  - Aimed at production and consumption of the ODS- Ozone Depleting Substances
  - Identified alternatives through scientific and technological assessment
  - Effective framework

Ozone and Climate Linkages



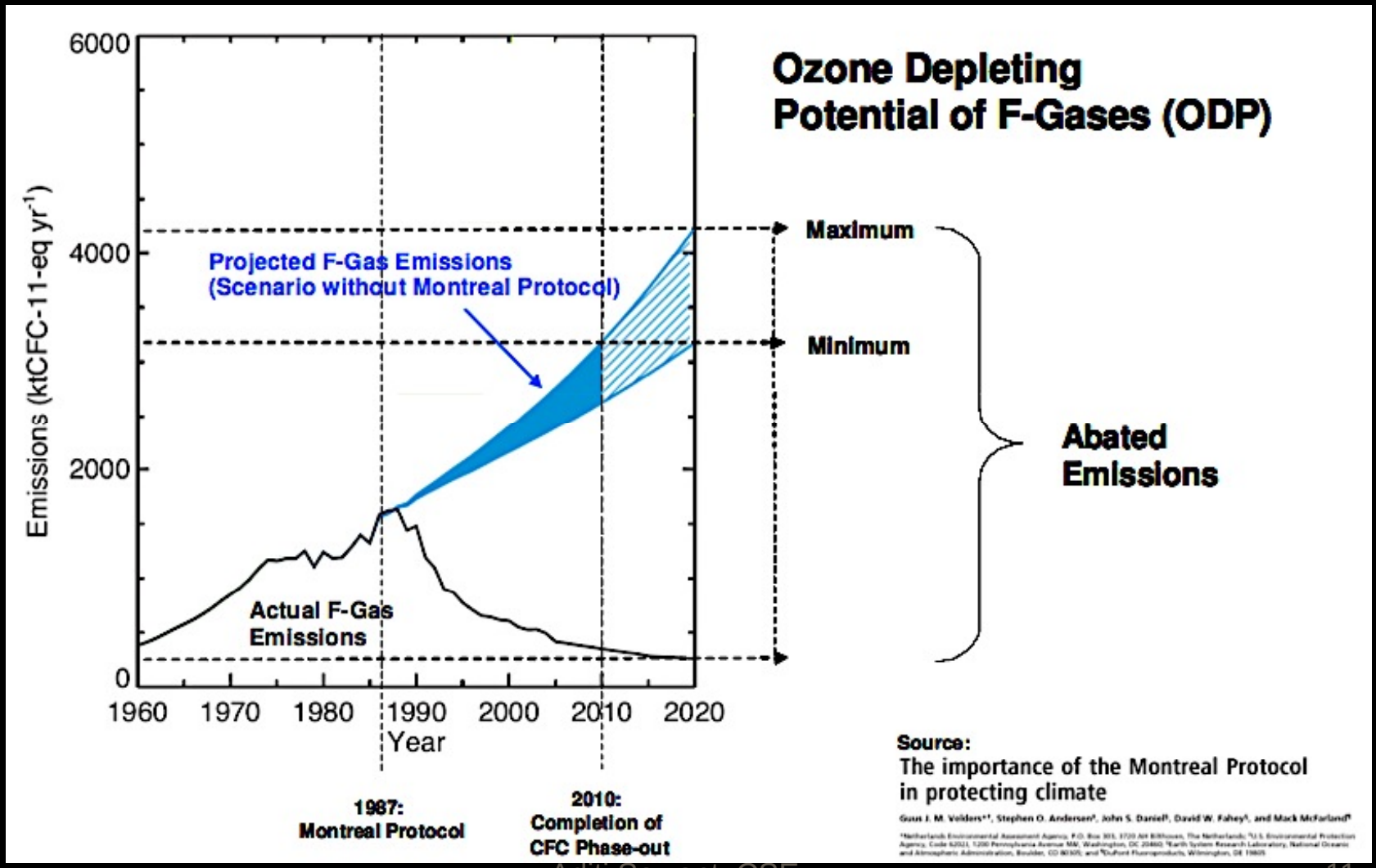
Therefore…

- Montreal Protocol as an incidental climate treaty
  - Phased out super-greenhouse gases
  - Spurred energy efficiency gains of upto 65 per cent from design improvements

Flagging 2 issues for later

- *Massive energy efficiency gains and;*
- *Leapfrogging*

Climate benefits of Montreal Protocol



What are HFCs?

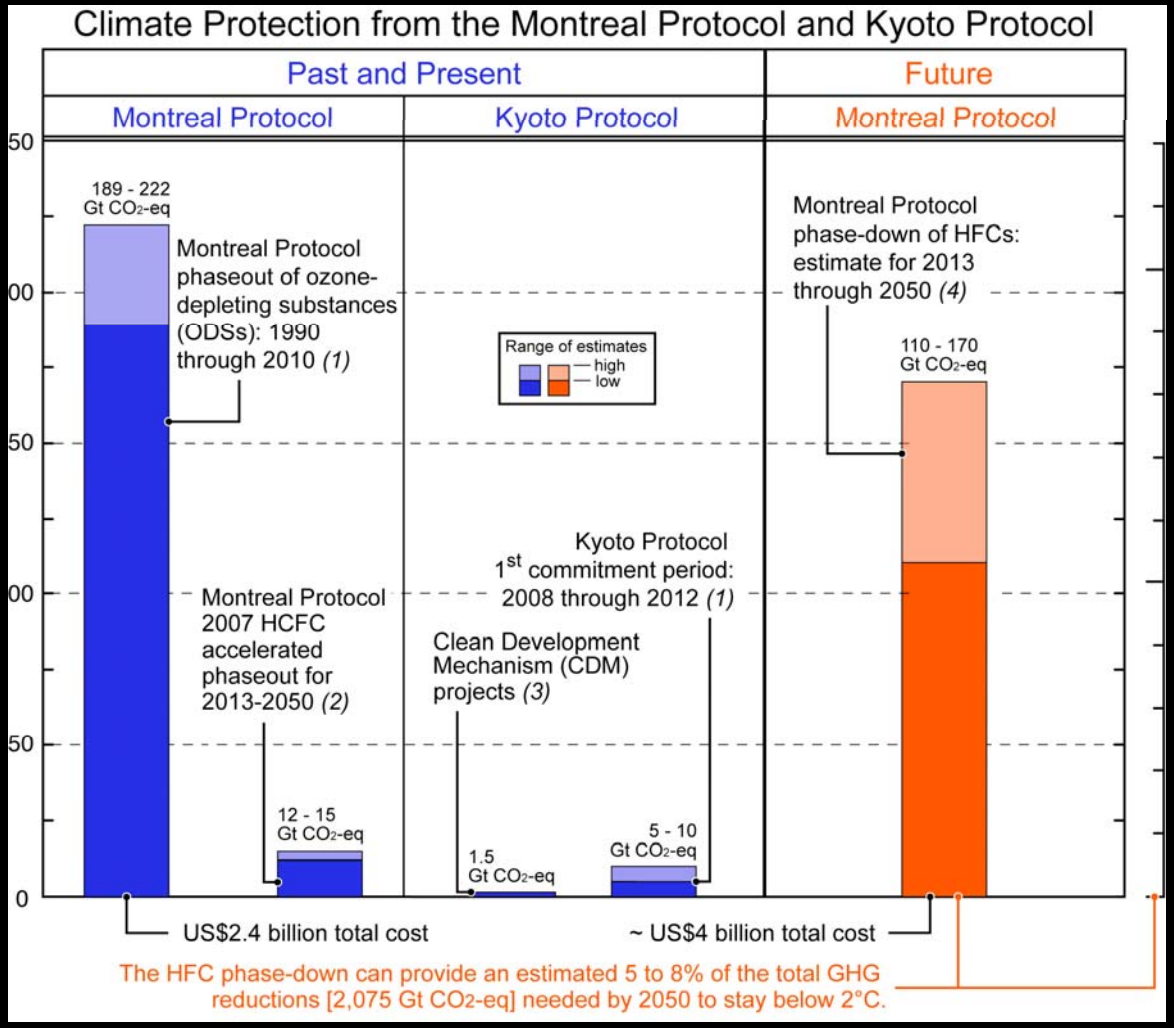
- Hydrofluorocarbons (HFCs) are man-made gases developed and commercialized to replace CFCs, HCFCs and other chemicals that deplete the ozone layer.
- Unlike CFCs and HCFCs, HFCs do not destroy ozone. However, they are powerful greenhouse gases (GHGs), with global warming potentials (GWP) hundreds or thousands of times more powerful than carbon dioxide (CO2).
- HFCs are primarily used in refrigeration, air conditioning, foam blowing, aerosols, fire protection and solvents.

GWP= Global Warming Potential

HFC-23	11,700
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-227ea	2,900
HFC-245fa[a]	-
HFC-365mfc[a]	-
HFC-43-10mee	1,300

Some blends have higher global warming potential of ~3000

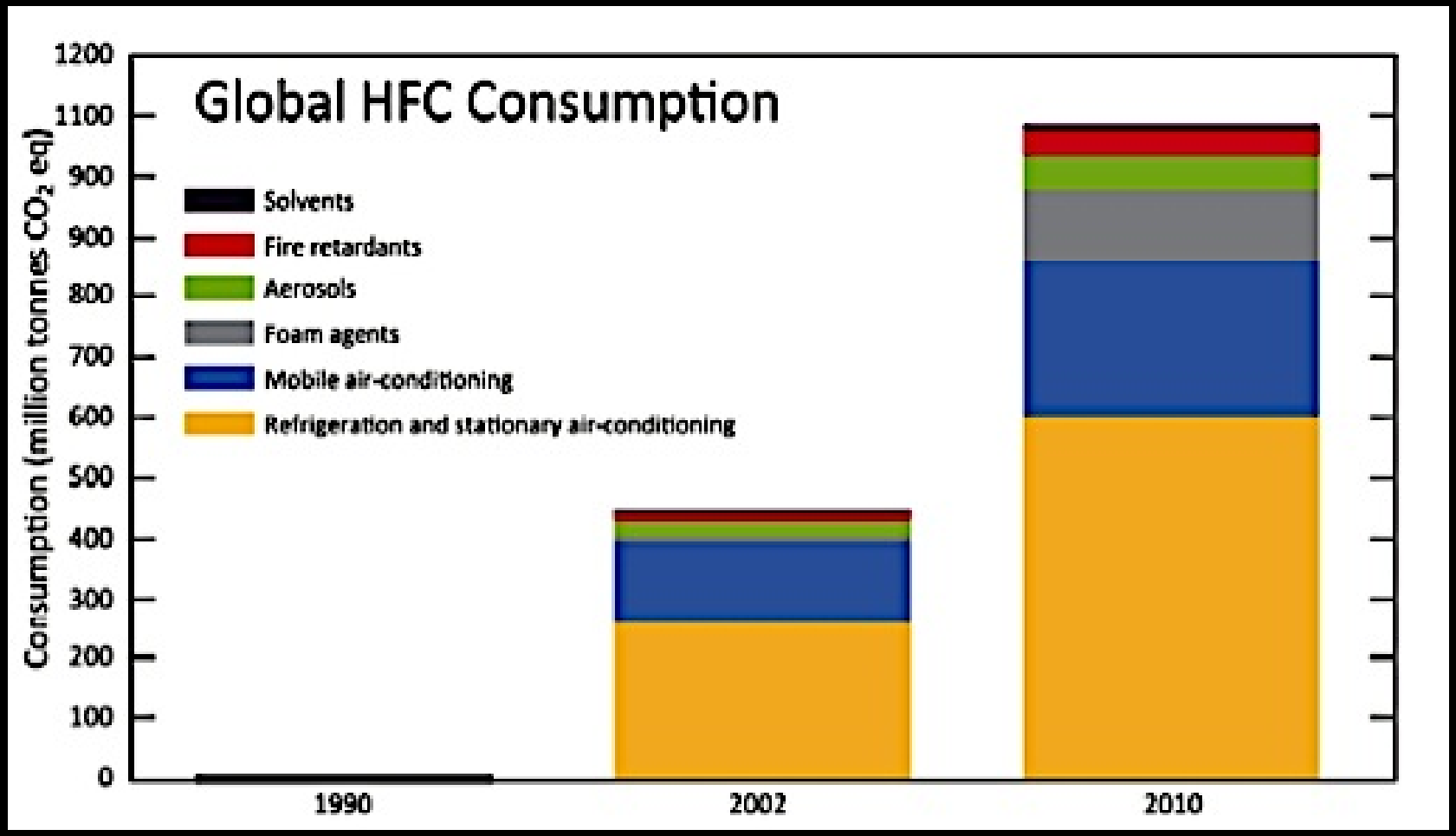
Upsetting the Offsets?



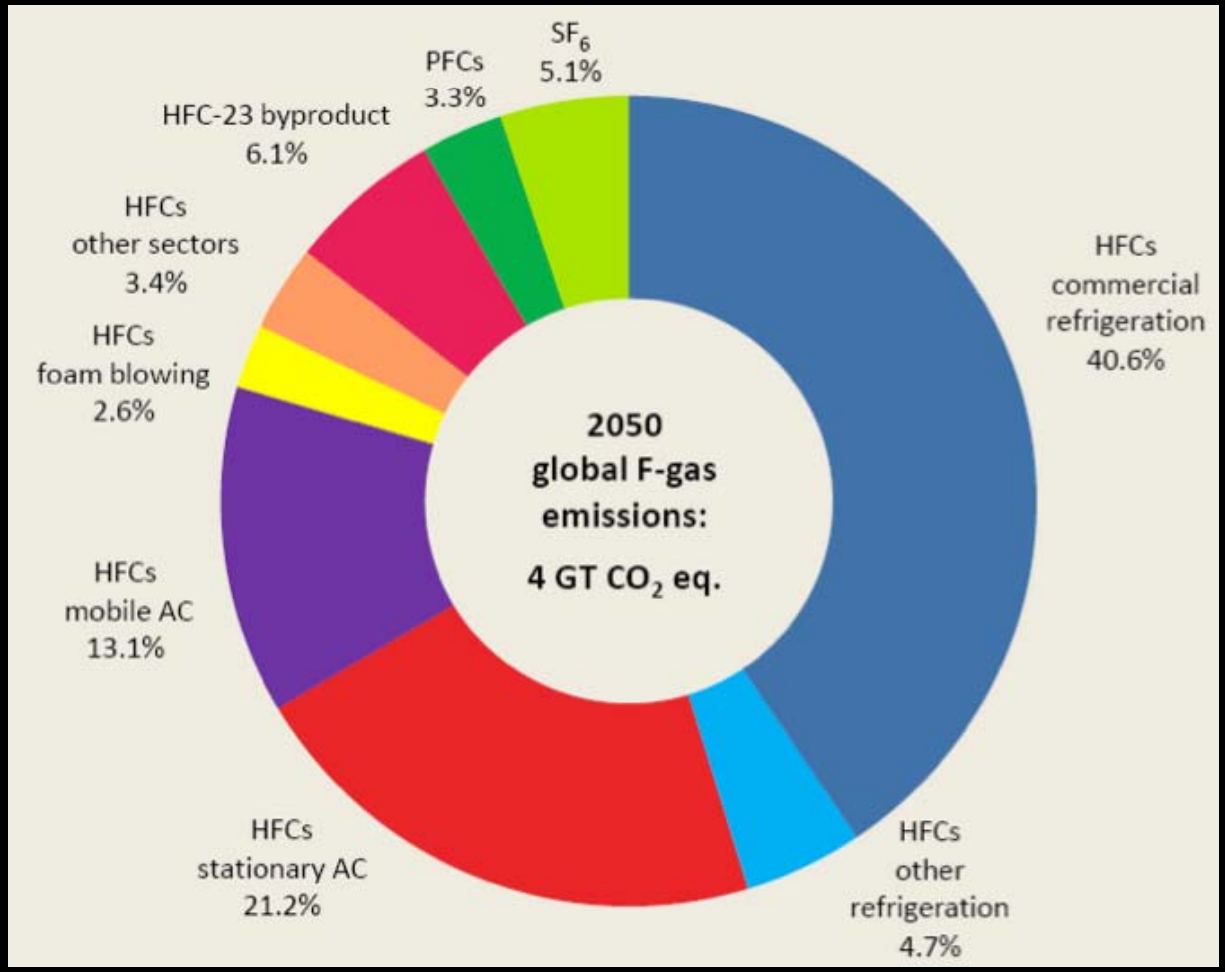
Some numbers to keep in mind

- HFC emissions growth will dramatically outstrip all other GHGs and, by 2050, will reach 5.5–8.8 Gt CO2e. per year. This is equivalent to 9-19% of projected global CO2 emissions under business-as-usual scenarios, and 28-45% of global CO2 emissions under a 450 parts per million (ppm) stabilization scenarios.

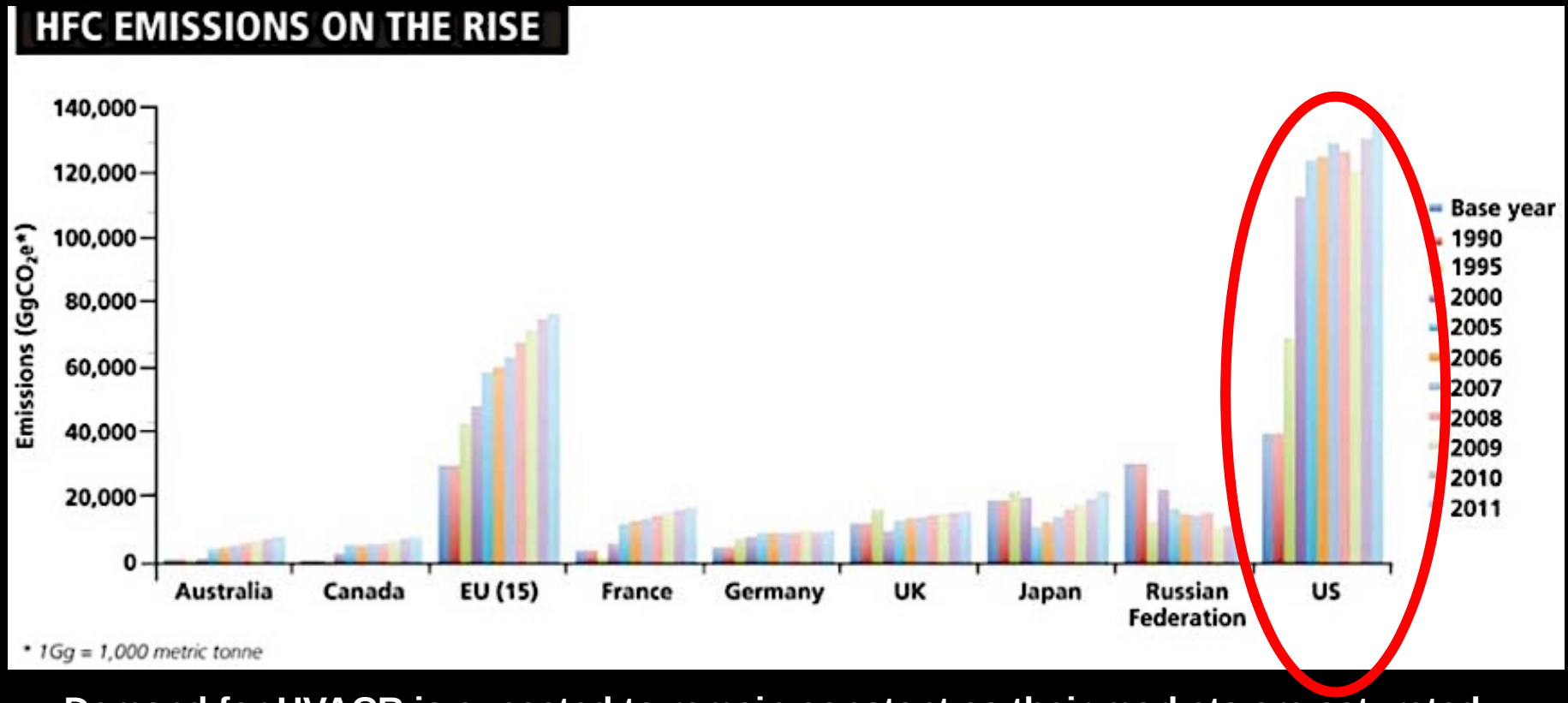
Growth in Global Consumption



Global F-gas emissions



Who is really responsible?



Demand for HVACR is expected to remain constant as their markets are saturated to a large extent with high GWP HFCs and population growth is expected to be low. Demand likely to grow in non-saturated markets such as Europe, due to rise in annual temperatures on account of climate change

Focus on RAC

Growing demand in developing countries

- Free trade, continued innovation, and a stable political and social climate are assumed to enable developing regions to access knowledge, technology, and capital.
- Rapid shift in demographics has led to acceleration of **economic growth**.
- Sector expected to grow as the demand for heating and cooling rises when population grows, economies develop and urbanization proceeds.

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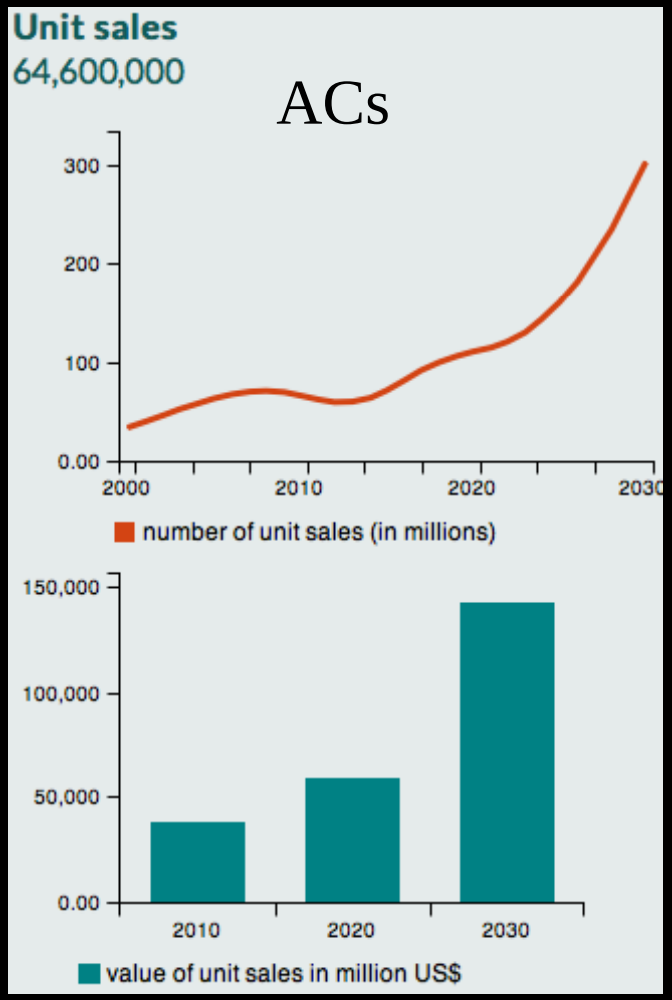
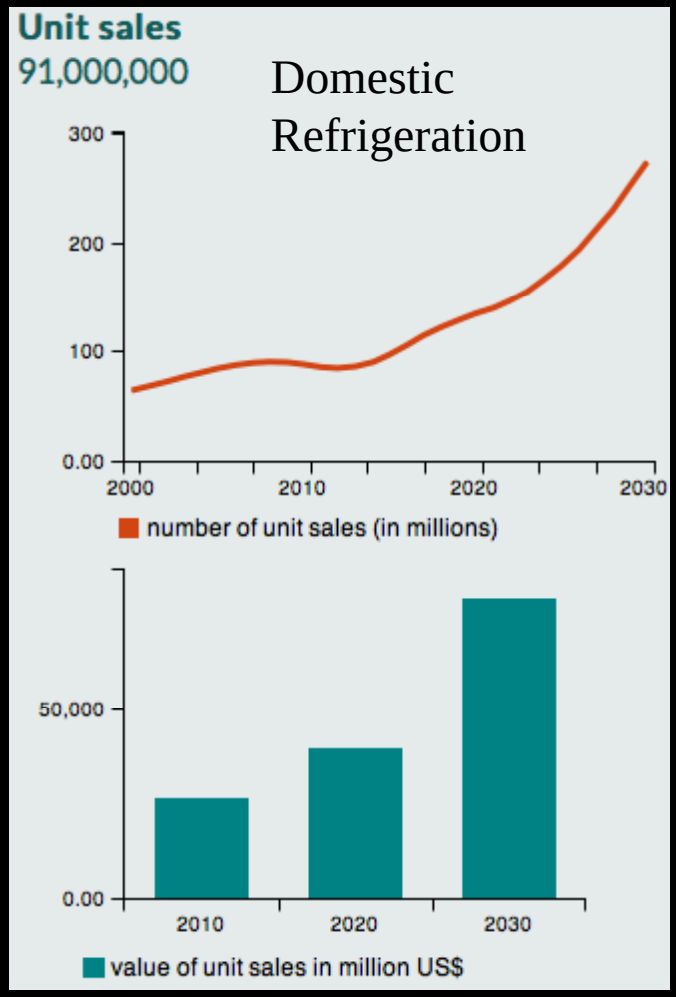
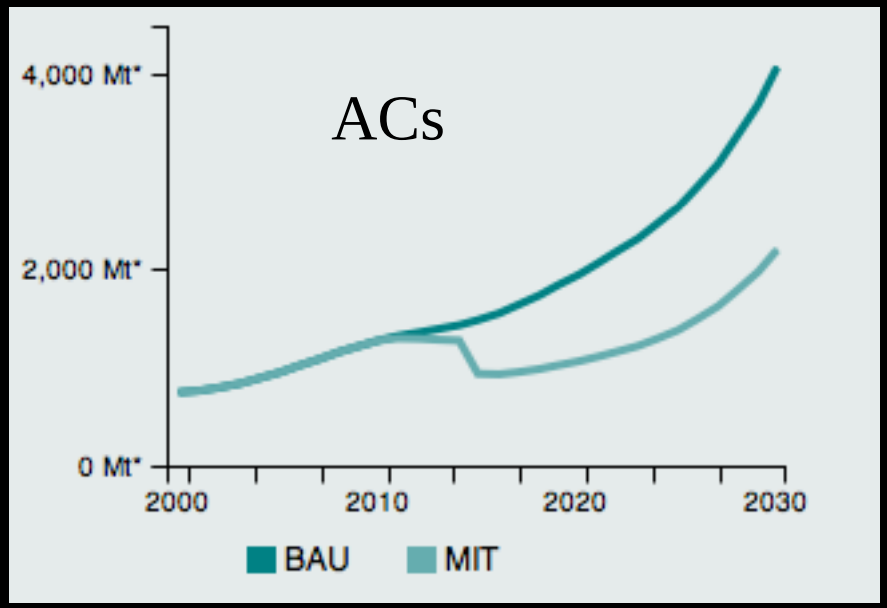
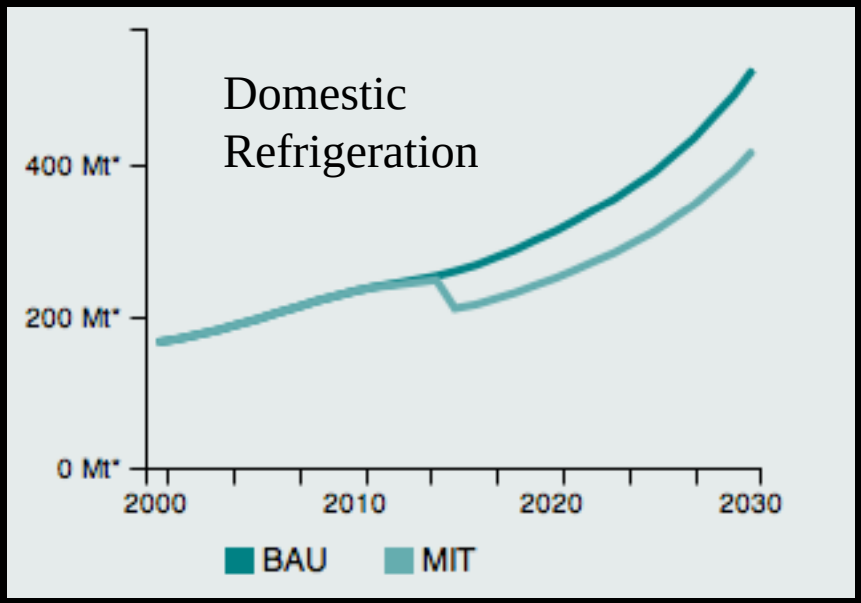

Unit sales
64,600,000
ACs
300
200
100
0.00
2000
2010
2020
number of unit sales (in millions)
150,000
100,000
50,000
0.00
2010
2020
2030
value of unit sales in million US$


Unit sales
91,000,000
Domestic
Refrigeration
300
200
100
0.00
2000
2010
2020
2030
number of unit sales (in millions)
50,000
0.00
2010
2020
2030
value of unit sales in million US$

Mitigation potential





International Momentum

- Why phase-down HFCs under the Montreal Protocol?
  - HFCs belong to the family of gases (F-gases), which possess similar chemical properties, are used in the same applications as substances regulated by the Montreal Protocol
  - Article 2 of the Vienna Convention calls upon states… to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer

Contd…

- HFC obligations under the Kyoto Protocol stay untouched
- The UNFCCC envisions and encourages cooperation with existing international institutions in Art. 7(2)(I) and the Kyoto Protocol has already relied on other international organizations to reduce GHG emissions in specific sectors in Art. 2(2). Similarly Article 2 of Vienna Conventions also encourages cooperation between treaties and their bodies

Contd…

- Montreal has used CBDR is various forms such as financial mechanism that pays certain costs of compliance, grace period with reduction to be led by developed countries
- Mechanisms, body, expertise all in place.

Contd…

- Cost for phasing down HFCs is fraction of the price currently being paid through the CDM for equivalent reductions

AND

- Will help in avoiding 0.5 degrees of warming by 2100

- There are 4 proposals currently on the table
  - North American
  - Micronesian
  - Indian
  - European

So what's the hold up?

- The Gas Game
  - Those who do not learn from history are condemned to repeat it
  - Business of alternatives
  - F-gas industry in developing countries got wind of such lucrative business opportunities
  - CFC phase out paid for under Montreal: US$ 82 million shared between 2 countries in the production sector.

- The developed countries saw an opportunity to sell us their outdated HCFC technology
- The developing countries too saw an opportunity here:
  - Moved to HCFC-22
  - Byproduct HFC-23 (potent greenhouse gas – 12,000 times more than CO2) had to be destroyed/CDM

Contd…

- Every tonne of HFC 23 destroyed companies earned 11,700 CERs – selling at Euro 12-15 per unit.
- 1 tonne of HCFC-22 = 30 kg of HFC-23
- Good business; produce more HCFC; make more potent climate gas; get paid!
- Companies made hundreds of millions in pure profit!
- Carbon markets flooded with CERs from such projects. This was one of the reasons of the fall of the carbon markets

- China makes 92% of HCFC; got most out of it; India followed
- Companies earned 50-100 times more money by selling CERs than cost of incinerating gas (~Rs. 10 to burn; Rs 800 from selling)

- On the ‘chemical treadmill’
- CFC-HCFC-to **HFC 410a** and **HFC 407c** (2000 times more potent than CO2)
- US/DuPont pushing HFO (hydrofluoroolefins) – 4th generation product
- Japan/Daikin pushing HFC-32 (700 times more potent than CO2; more energy efficient so less in-direct emissions)

Basis for evaluation of the proposals

- Grace Period
- Baseline
- Leapfrogging high-GWP alternatives
- Energy Efficiency
- Costs and Financial mechanism
- Technology transfer
- Relation to UNFCCC
- HFC-23
- Banks

CSE is analyzing the impact of these proposals

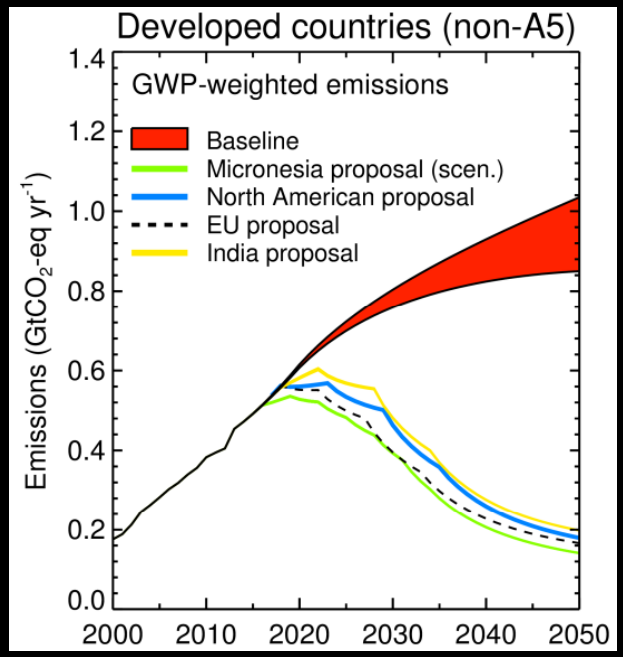
Grace Period

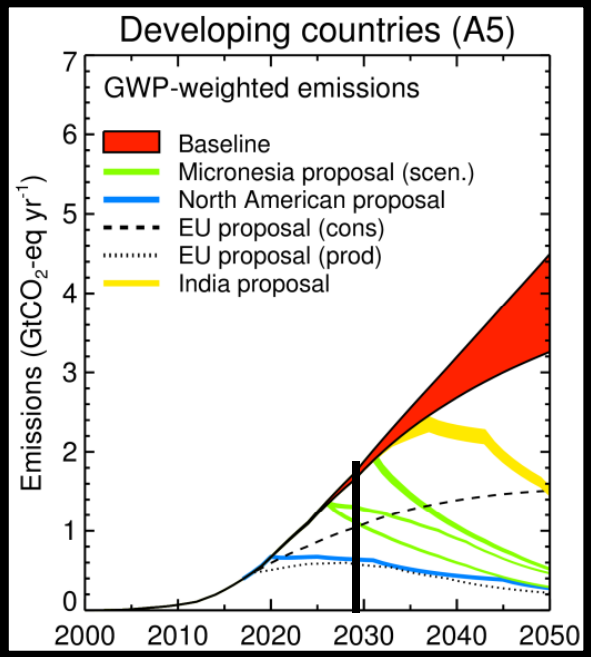
	North American	Micronesian	European	Indian
Grace Period	Two years each and for the last step 10 years	Incremental gap of 3-4-5-6-years	6 years	15 years
Reduction Steps	Article 2 2019 = 90% 2024 = 65% 2030 = 30% 2036 = 15%	Article 2 2017 = 85% 2021 = 65% 2025 = 45% 2029 = 25% 2033 = 10%	Article 2 2019 = 85% 2023 = 60% 2028 = 30% 2034 = 15%	Article 2: 2016 = 100% 2018 = 90% 2023 = 65% 2029 = 30% 2035 = 15%
	Article 5 2021 = 100% 2026 = 80% 2032 = 40% 2046 = 15%	Article 5 2020 = 85% 2025 = 65% 2030 = 45% 2035 = 25% 2040 = 10%	Article 5* 2025 2029 2034 2040	Article 5 2031 = 100% 2050 = 15% Steps in between to be decided 5 years prior to the next 5 year period

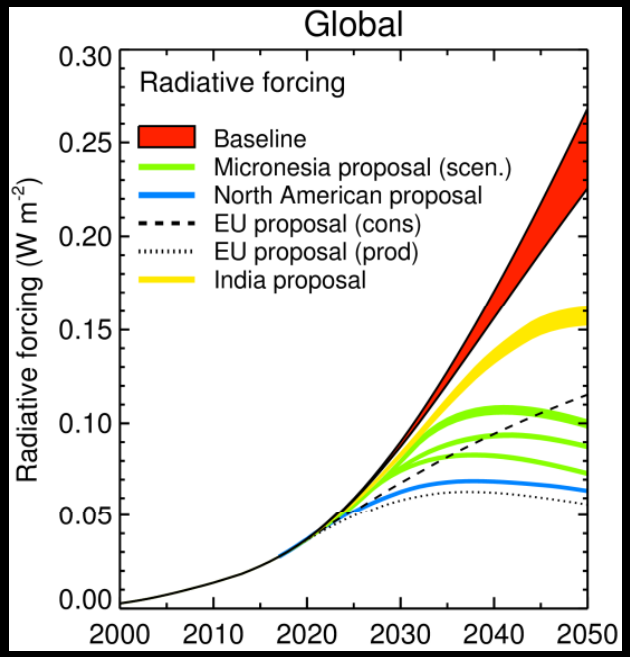
Baselines

North American	Micronesian	European	Indian
Article 2 100% HFC + 75% HCFC for 2011-2013	**Article 2** 100% HFC 2011-2013+ 10% HCFC Baseline	**Article 2** 100% HFC 2009-2012+ 45 % HCFC 2009-2012 (in CO_2e)	**Article 2** GWP weighted avg. 100% HFC 2013-2015 + 25% HCFC Baseline
Article 5 100% HFC+ 50% HCFC for 2011-2013	**Article 5** 100% HFC 2015-2017+ 65% HCFC Baseline	**Article 5** 100% HFC 2009-2012+ 45 % HCFC 2009-2012 (in CO_2e)	**Article 5** GWP weighted avg. 100% HFC 2028-2030 + 32.5% HCFC Baseline

This is how the proposals stack up





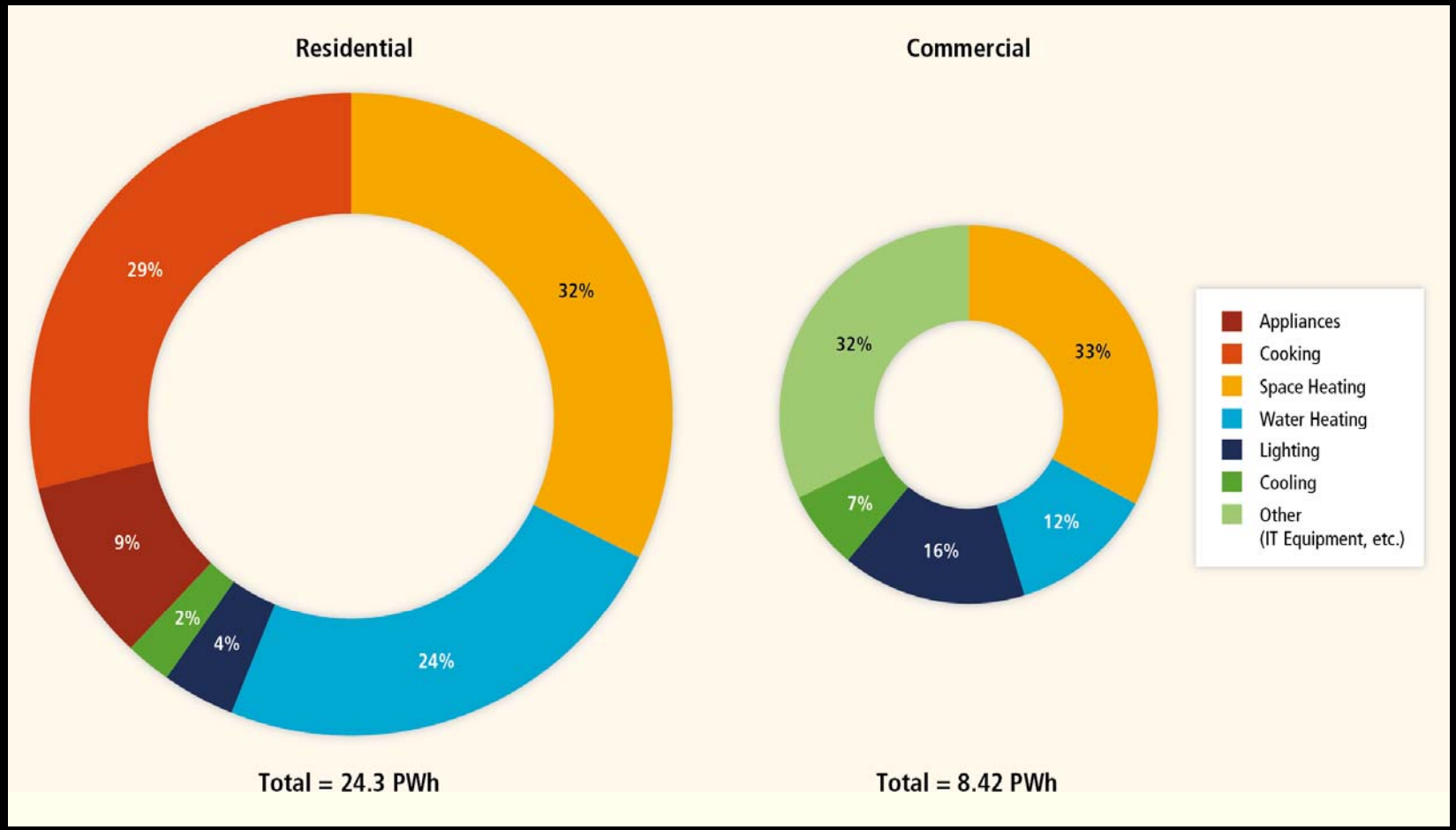


Phasing-down HFCs: Opportunities

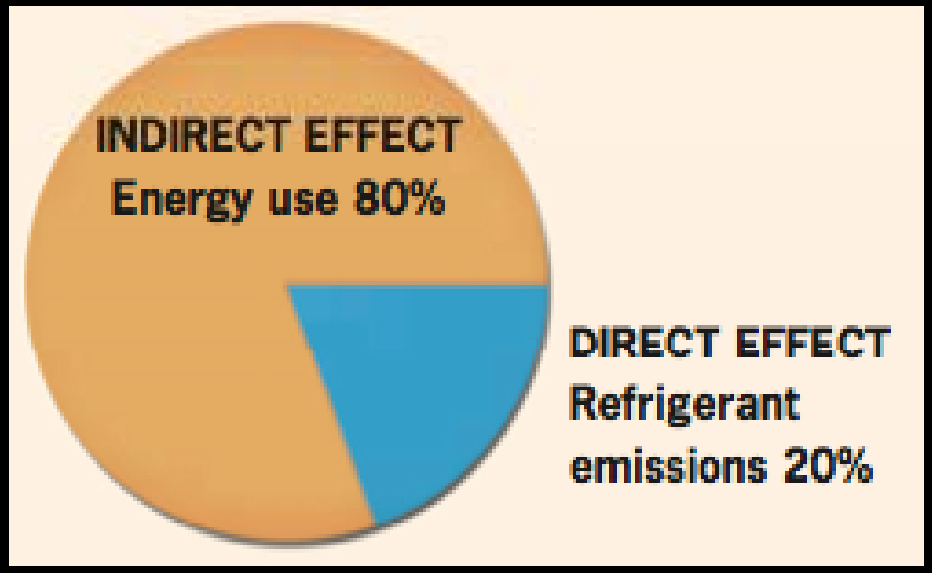
The co-benefit agenda

- Energy Efficiency
- Leapfrogging
- Elimination of banks

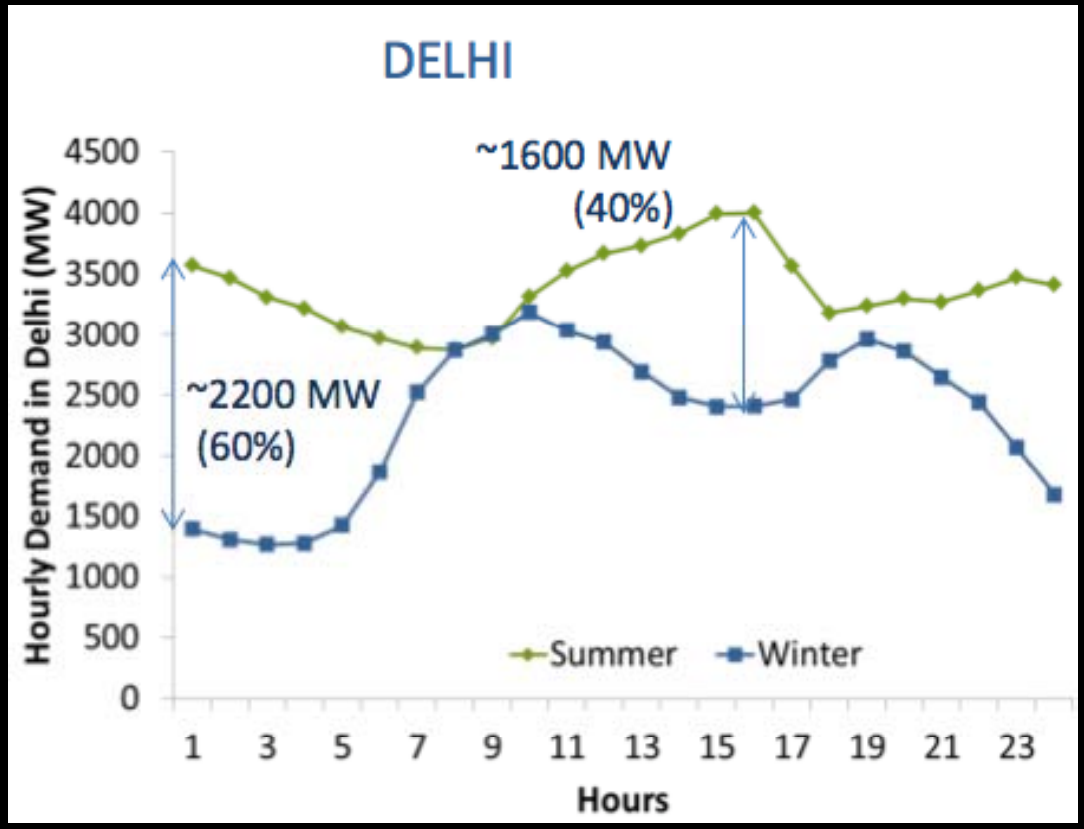
World energy consumption in buildings



Energy Efficiency



- Much of the growth in India's primary energy consumption is driven by its rapidly expanding A/C and refrigeration sectors.
- Space cooling can account for 40-60% of peak summer energy load in cities with hot climates, such as Delhi, and is the largest contributor to peak load from household appliances


DELHI
~1600 MW
(40%)
~2200 MW
(60%)
Hourly Demand in Delhi (MW)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Summer
Winter
1
3
5
7
9
11
13
15
17
19
21
23
Hours

Contd…

- Implications for energy security for developing countries
- Fourth-largest energy consumer
- Power deficit and blackouts
- Consumer saves
- Coal currently provides two-thirds of India's electric generating capacity and is a significant contributor to regional air pollution

Leapfrogging

- Maximum phase-out of HCFC is yet to happen
- This means there is a extensive potential for these applications to use HFC
- We can leapfrog HFCs and use alternatives with low global warming potential such as naturals- HCs, NH3, CO2, water etc. and not in kind technologies.
- Prevent obsolete technology from being locked in

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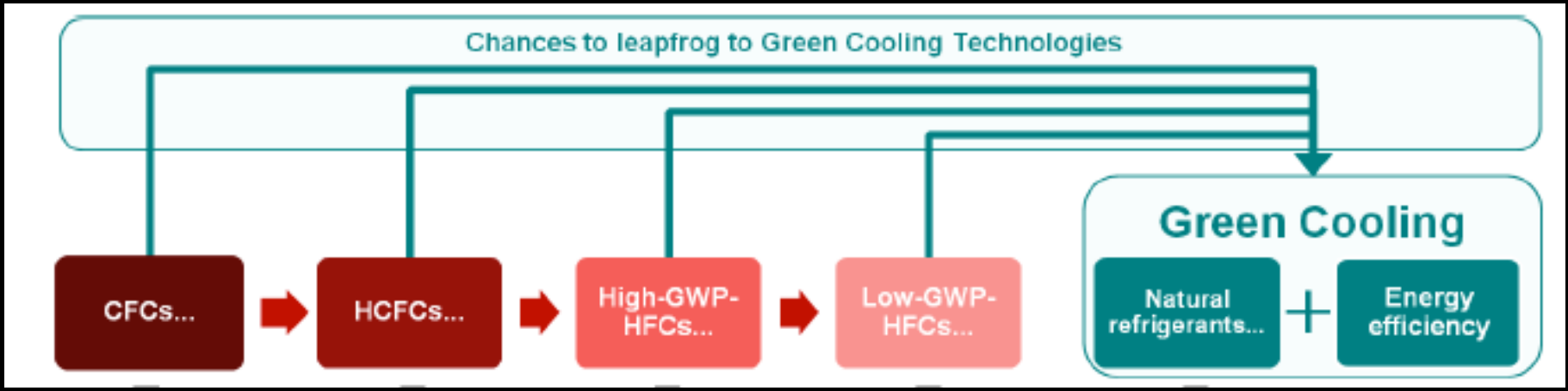


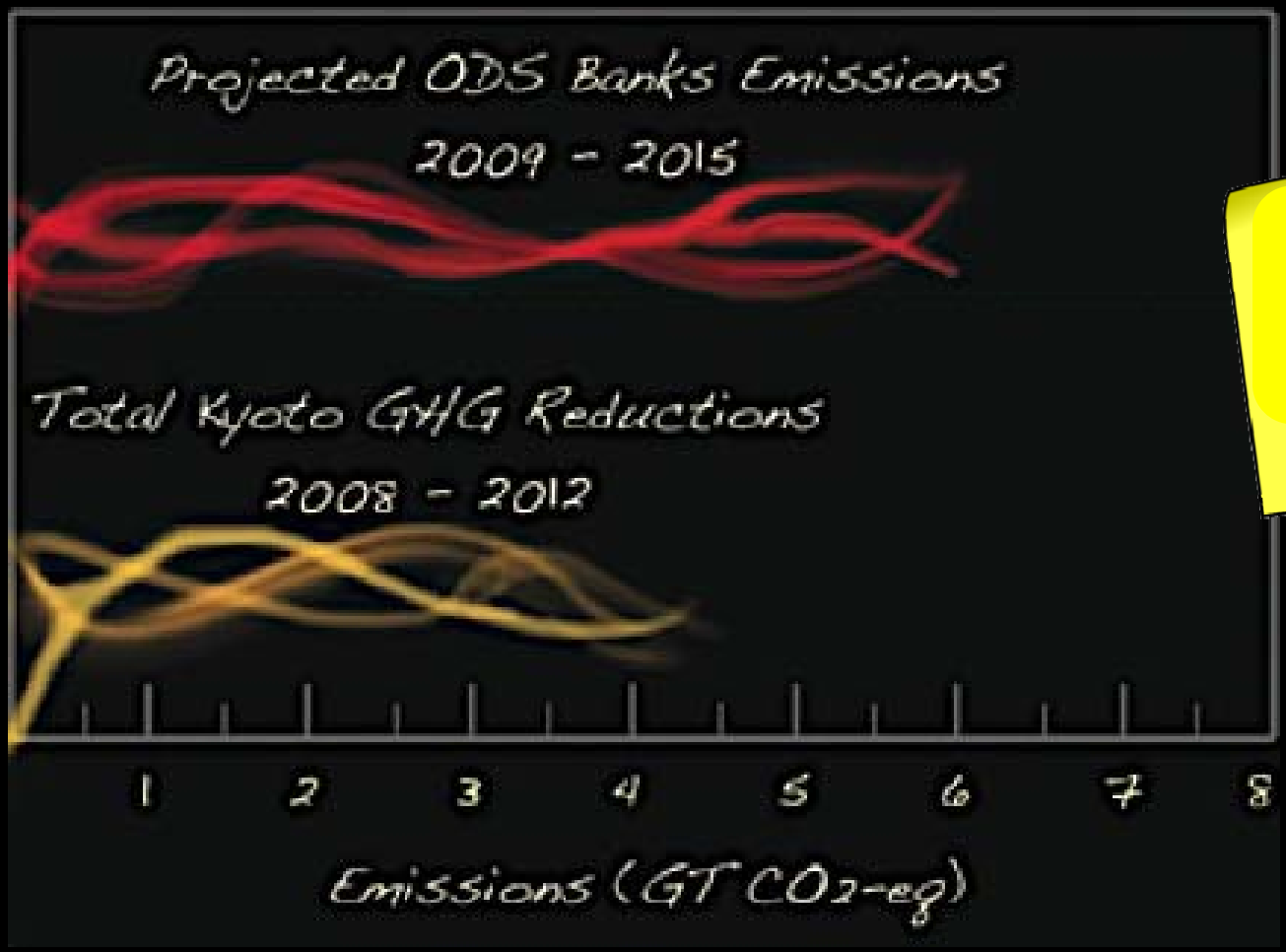
Naturals do not have patents and have energy efficiency gains

Alternatives are available

	Substance	ODP	GWP
Refrigeration	CFC-12	1	10,900
	HFC-134a	0	1,430
	HC 600a (Isobutane)	0	3
Air-conditioning	HCFC-22	0.055	1,810
	HFC-32	0	675
	HFC 410A	0	2,100
	HC-290 (Propane)	0	3
MAC	R-744 (CO_2)	0	1
	R-1234yf (HFO)	0	3

Simplified overview

Elimination of banks



Could be included in the proposals

Summary and Conclusions

- Issues of alternatives/patent/cost should be resolved
- Best option is to find ways to incentivize hydrocarbon – no patent
- Single-transition needed – how will this work?
- Unique opportunity to tap into energy efficiency benefits that can be gained under the Montreal Protocol- need to incentivize energy efficiency
- Cannot let commercial interest rule decisions of Montreal Protocol

Conclusion

- Discussions, for an HFC amendment must have only two points that serve as starting points and ending points- attainment of our 2 degree climate goal and maintaining the common but differentiated responsibility principle.

THANK YOU

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Back up slides

Phasing-down HFCs: Challenges

- Technological issues
  - Not much encouragement to natural alternatives
  - Technology transfer and IPR
  - R&D
  - Need for information and evaluation of alternatives
  - Penetration technology in developed countries is low
  - Need for demonstration projects
  - Safety issues

- Financial issues
- MLF estd. under Article 10 deals with finance
  - Cost-effectiveness thresholds low
  - Low incremental costs-ICC and IOC
  - Fund replenished every 3 years. Each time the level of replenishment is inadequate
  - Must find a way to galvanize climate benefits and incentivize energy efficiency gains

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