



**ATMO**  
sphere

**n e t w o r k**  
Natural Refrigerants

---

**07/06/18 - Johannesburg**





## **CO2 past, present and future**

Kenneth B. Madsen

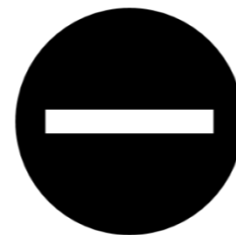
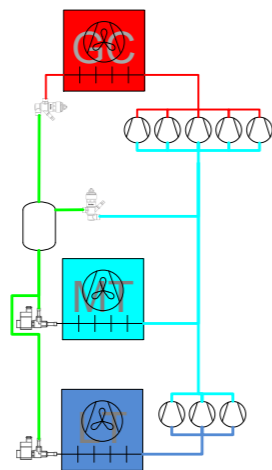
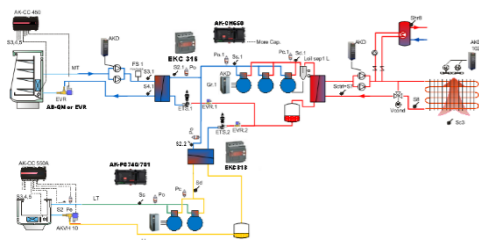
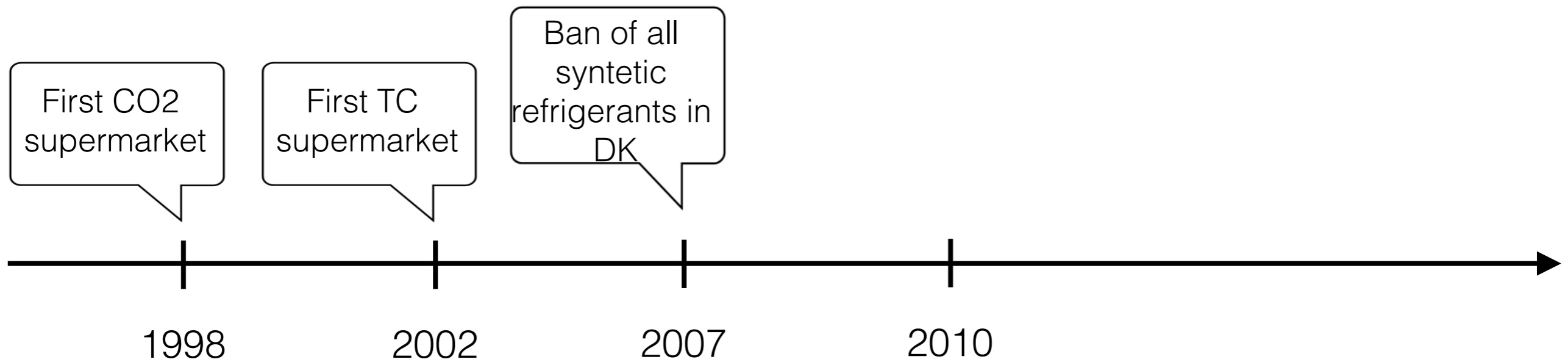
# Content

- A historical walk through on CO2 development, main milestones
- Where are we with CO2 today
- Challenges for the future
- Solutions for the future



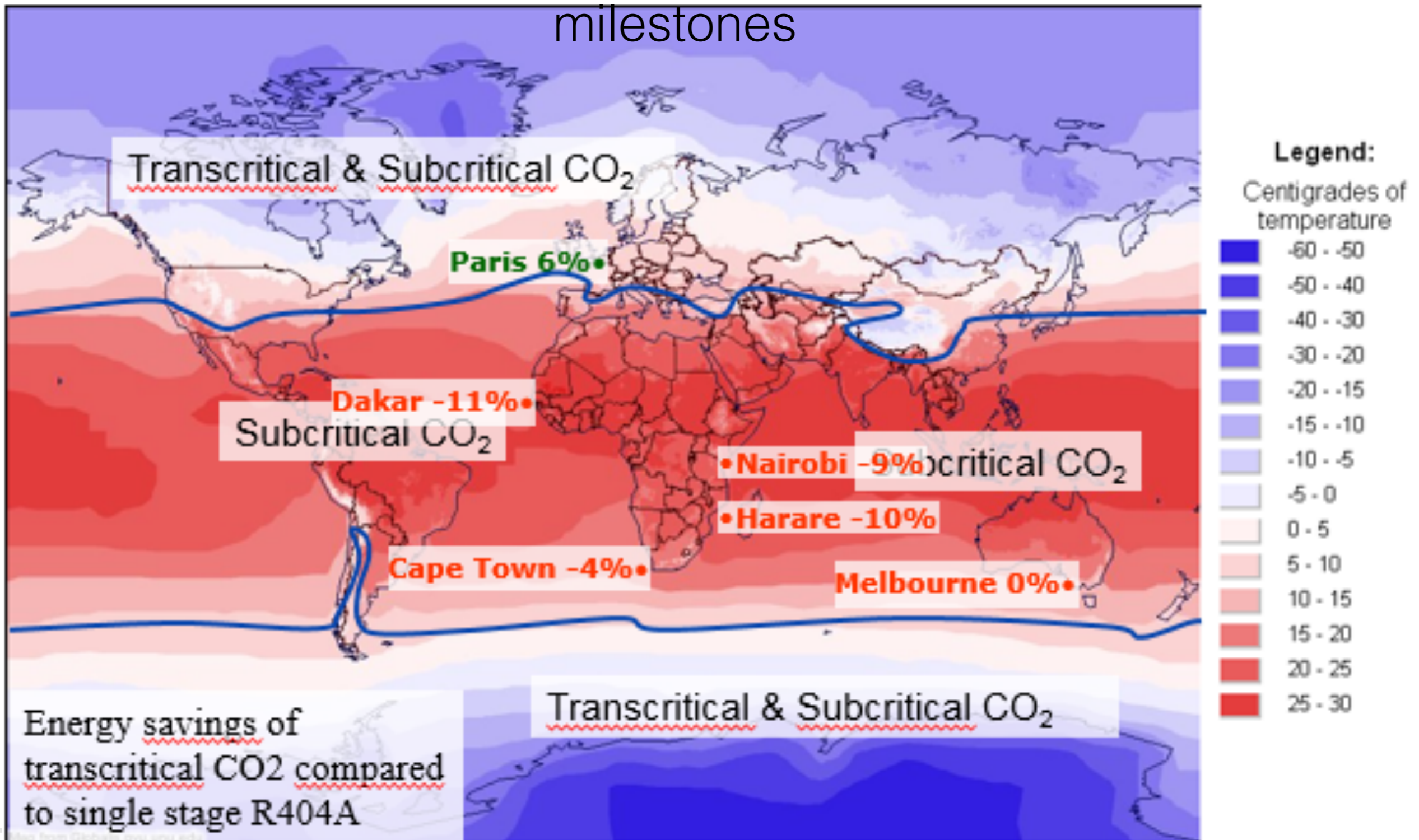
# A historical walk through on CO2 development, main

## Getting the basics right





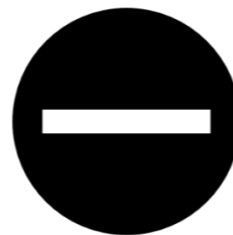
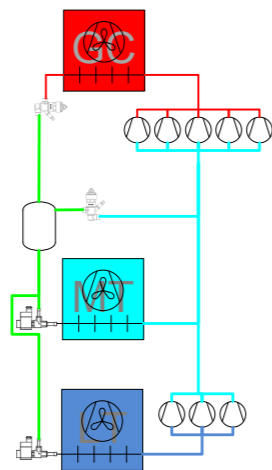
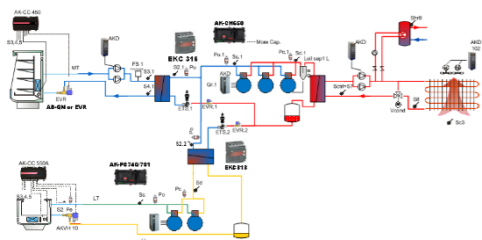
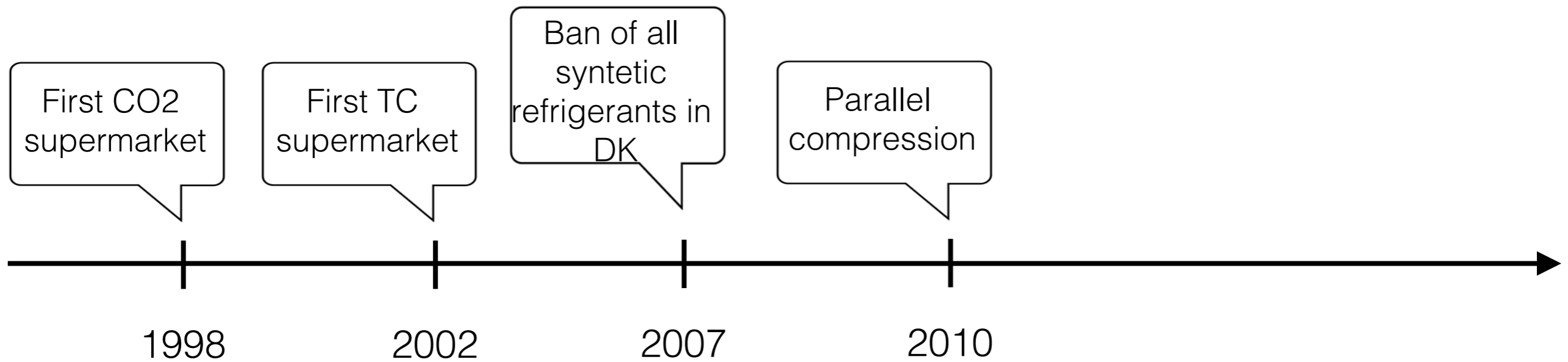
# A historical walk through on CO2 development, main milestones



# A historical walk through on CO2 development, main

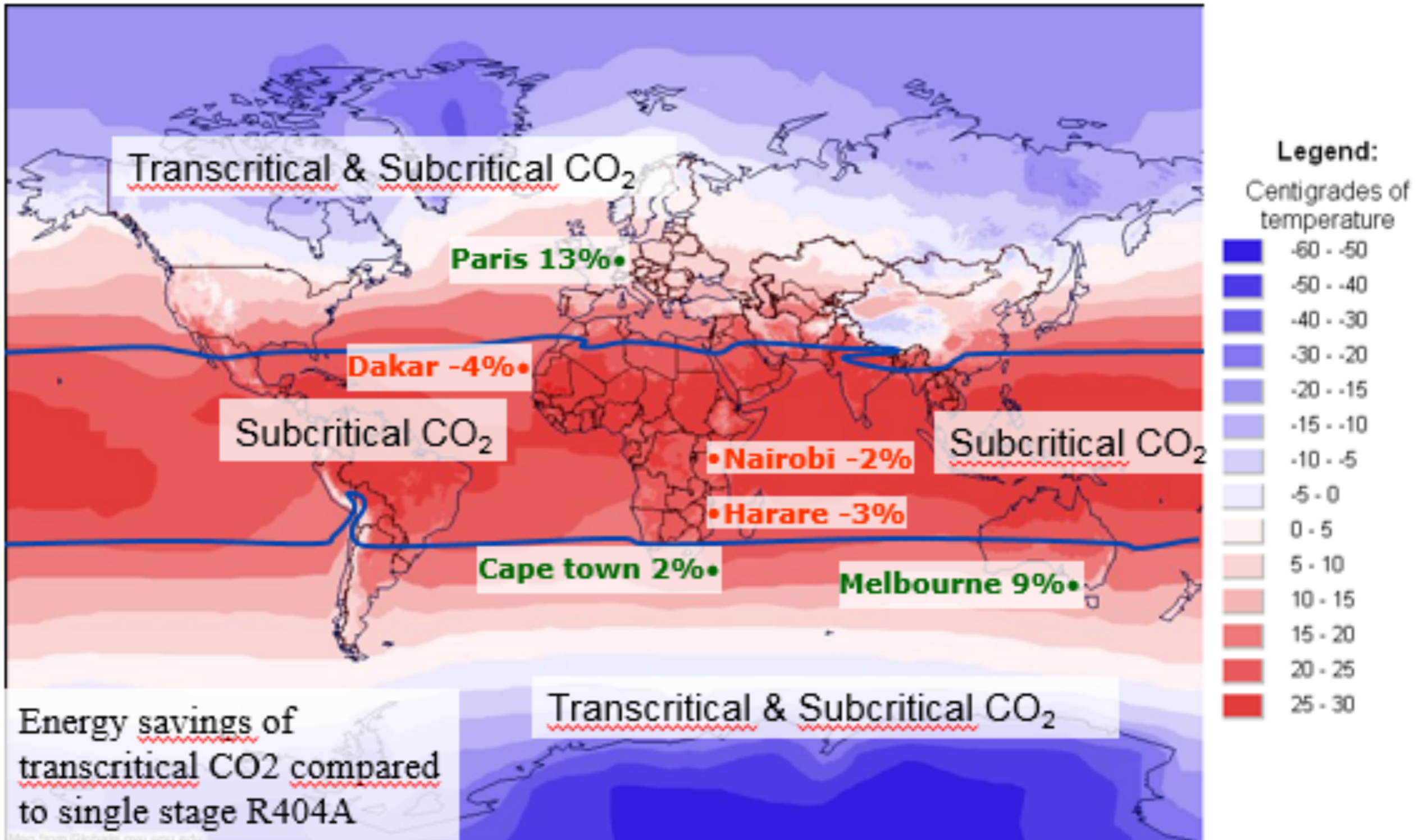
Getting the basics right

Getting going (energy)



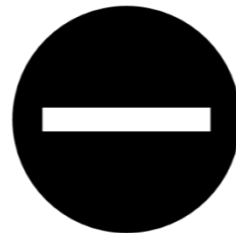
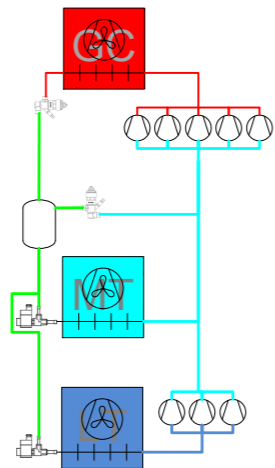
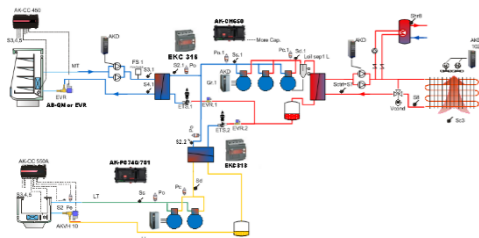
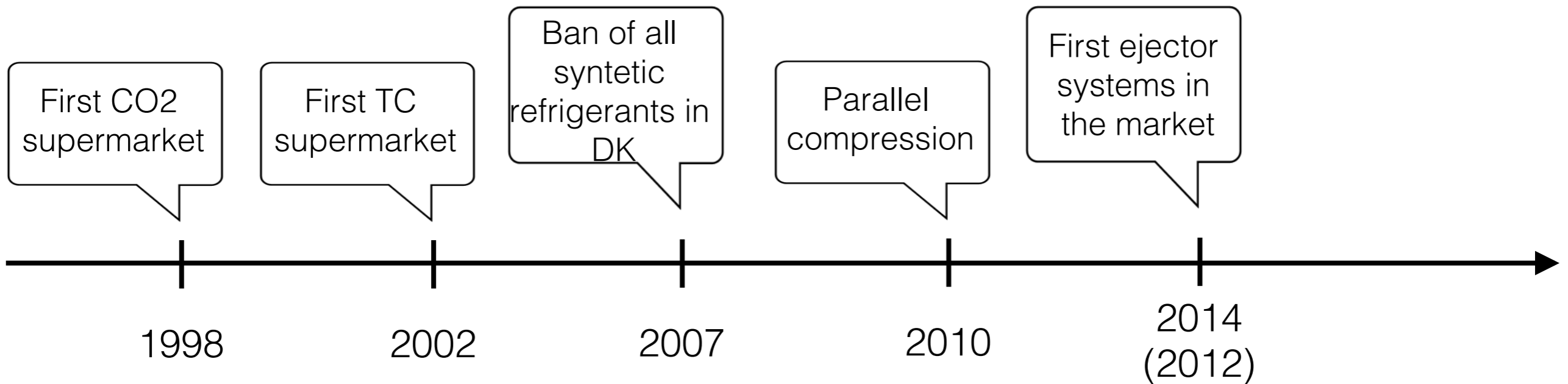


A historical walk through on CO2 development, main



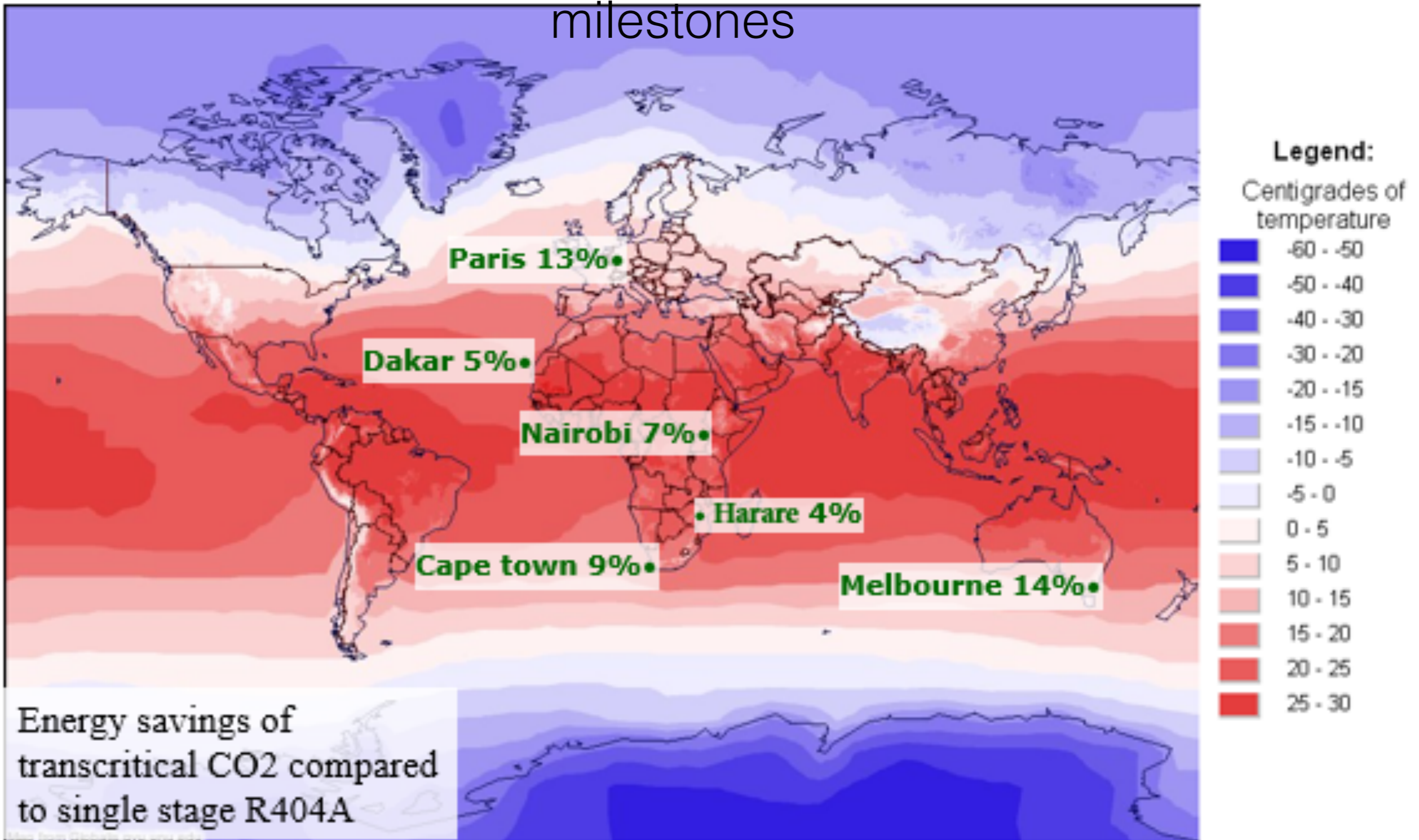
# A historical walk through on CO2 development, main

Getting the basics right      Getting going (energy)





# A historical walk through on CO2 development, main milestones

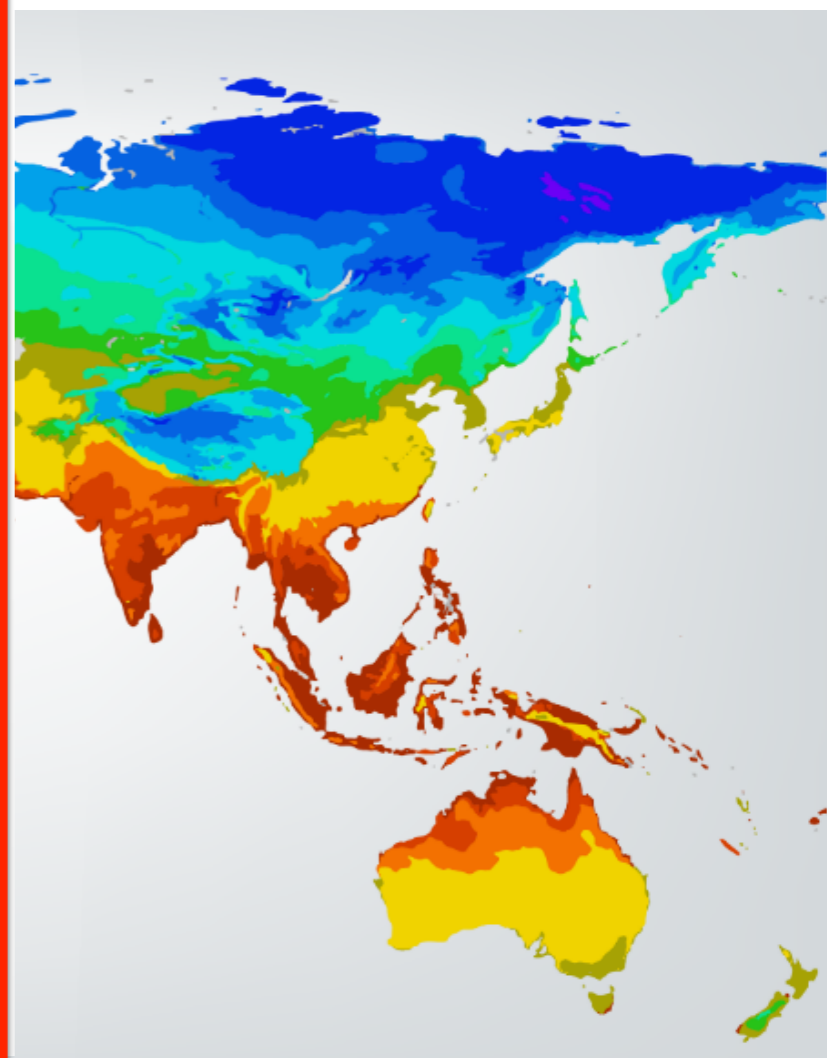


The map illustrates energy savings based on temperature and 3 different CO<sub>2</sub> systems compared to

2002 2010 <sup>stage R4</sup> 2014

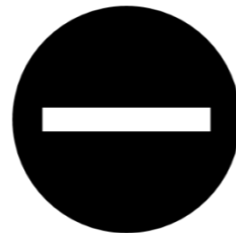
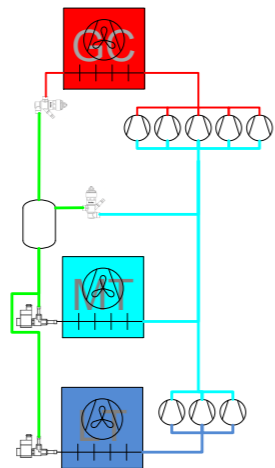
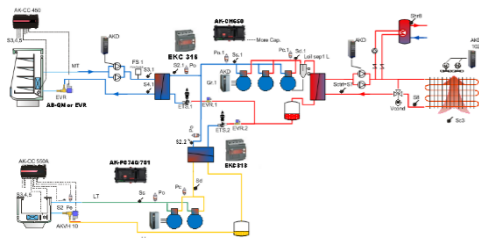
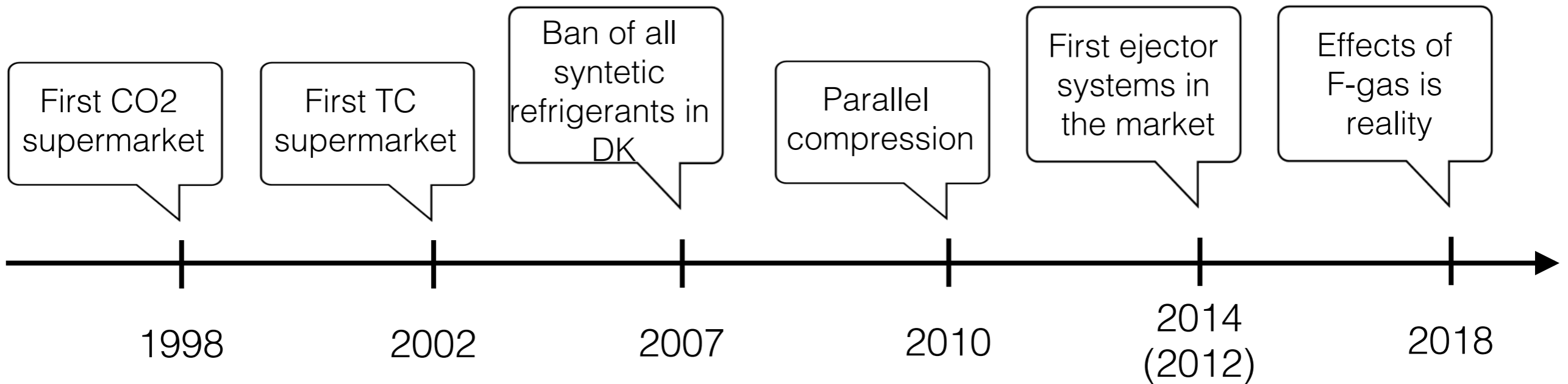
Yearly average temp C°	Yearly average temp F°	Booster VS R404A	Parallel compression VS R404A	Multi Ejector Solution HP VS R404A
0	32	23%	30%	30%
5	41	17%	24%	26%
10	50	8%	15%	18%
15	59	0%	6%	12%
20	68	-8%	0%	8%
25	77	-9%	-2%	7%
30	86	-5%	0%	10%

R404A



# A historical walk through on CO2 development, main

Getting the basics right | Getting going (energy)

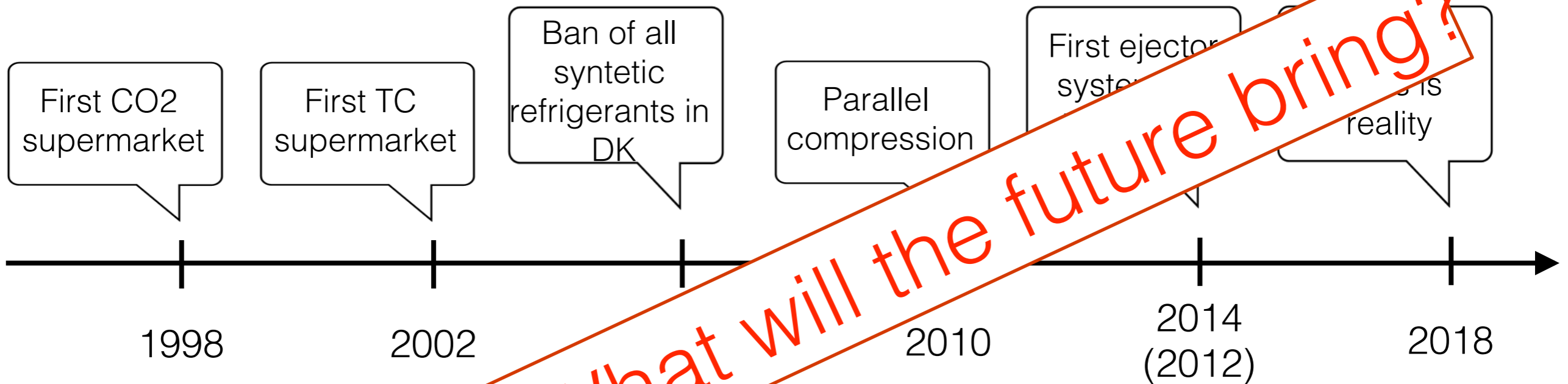
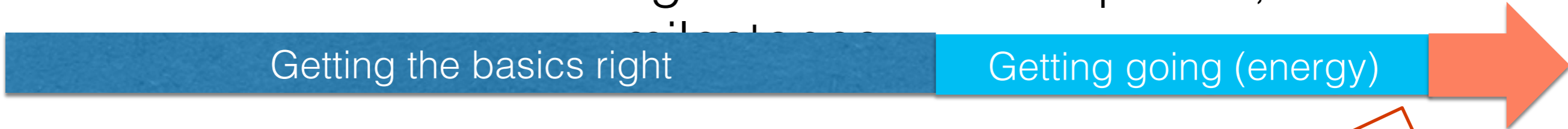




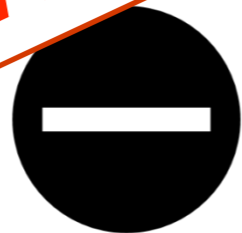
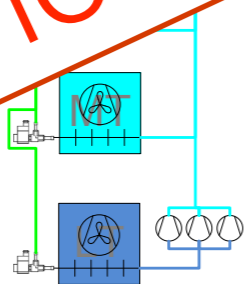
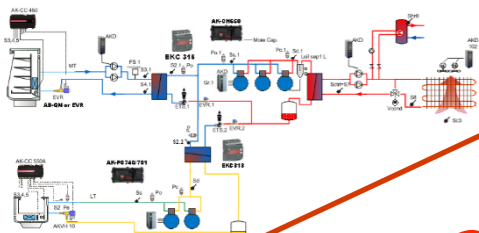
# A historical walk through on CO2 development, main milestones



A historical walk through on CO2 development, main



What now? What will the future bring?





## Challenges for the future

- With the Kigali amendment the world has agreed that we need to find a way to get the HFC usage under control
- For CO<sub>2</sub> to be a part for that solution we have some hurdles we need to overcome:
- Training of service and design people
- Cost needs to come down.



## Solutions for the future

- Mechanical valves needs to be developed to bring down cost
- Simpler controls with reduced complexity
- More training! There are things starting to make this happening but more is needed!







**ATMO**  
sphere  
network  
Natural Refrigerants

---

07/06/18 - Johannesburg

Thank you for listening.

