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All for dreams

A Nidec Group Company
SECOP

COMPRESSOR TRENDS FOR LIGHT COMMERCIAL APPLICATIONS

Secop

- A Nidec Group company
- Formerly Danfoss Compressors
- 102.000m2 of production area in Austria, Slovakia and China
- Application laboratories in Germany, Austria, USA, China and Turkey

Nidec

- 300 companies in 40 countries
- Approx. 130.000 employees
- USD 12B in sales
- Motors/fans for appliances, automotive, office equipment, IT/consumer electronics, commercial and industrial applications
- Refrigeration compressors
- Electronic/optical components and machinery

Secop Product Portfolio

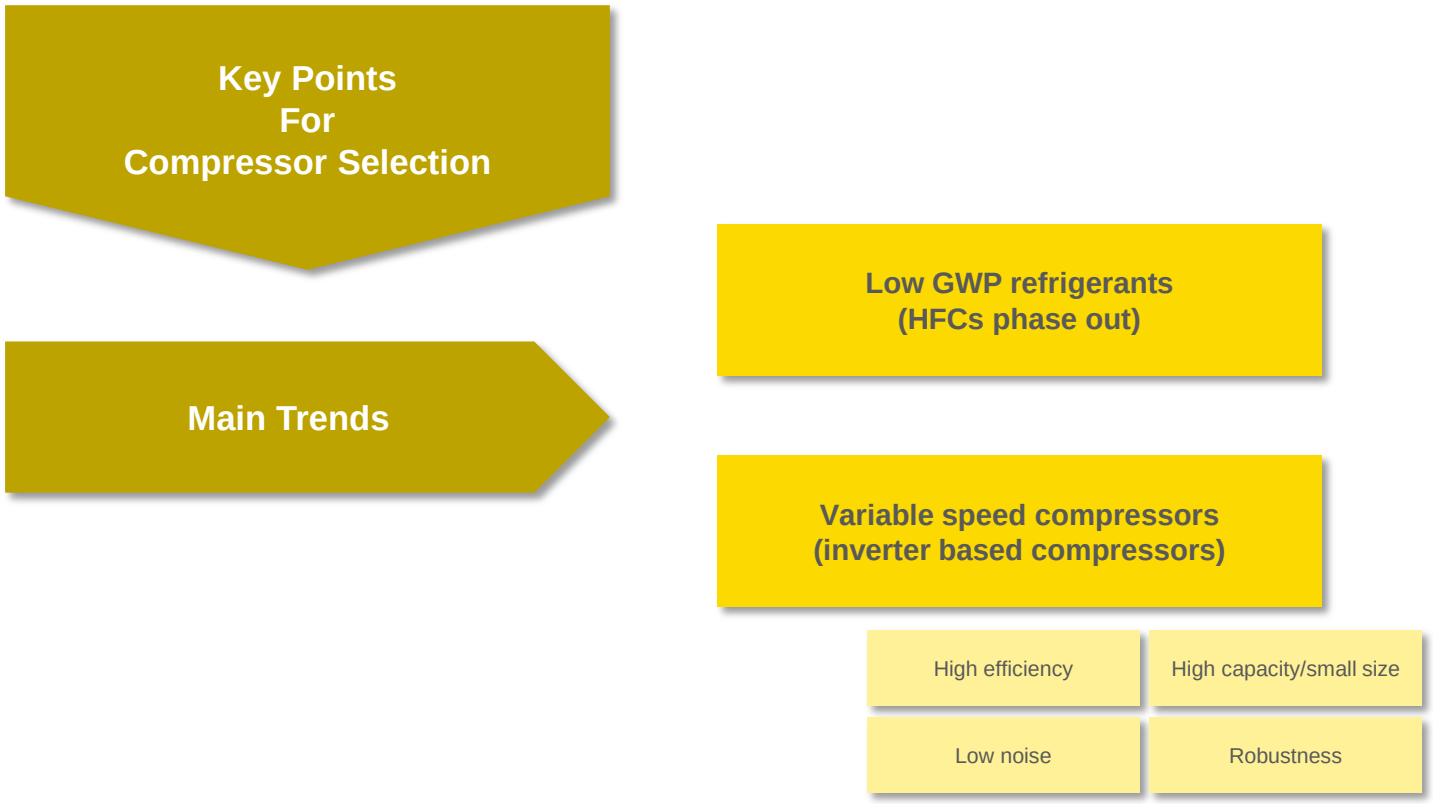
Household

Light Commercial

DC-Powered

Key Points for the Light Commercial Refrigeration

Main Trends in the Compressor Industry



GWP = Global Warming Potential ; HFC = Hydrofluorocarbon

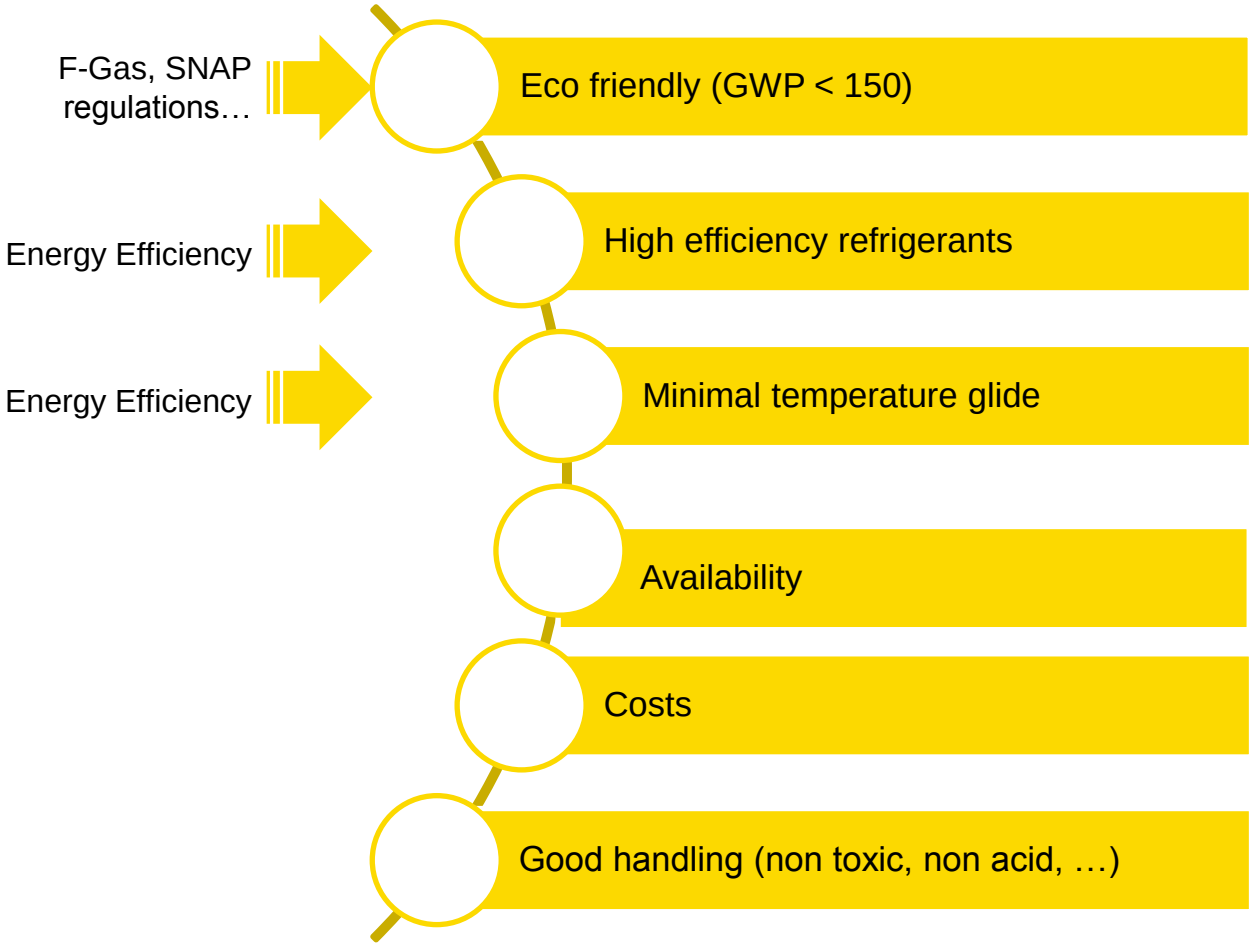
Low GWP Refrigerants

Roadblocks for the HFCs

- Governmental regulations applying phase out & production quota limits
- NGOs and big companies demanding “green” solutions
- Increasing prices due to potential scarcity

HFCs have a short life in the market

Choosing an Alternative Refrigerant



Refrigerants Comparison

	Commonly used HFC's		Available Natural Refrigerants			Released new Chemical Refrigerants						Announced new Chemical Refrigerants
	R134a	R404A	R290	R600a	R744	R1234yf	R448A	R449A	R452A	R455A	R513A	R454C*
Main Application	MBP	LBP	LBP/MBP	LBP/MBP	MBP/HBP	MBP	LBP	LBP	LBP/MBP	LBP/MBP	MBP	LBP/MBP
GWP	1430	3922	3	3	1	4	1273	1397	2141	145	631	146
Flammability	A1	A1	A3	A3	A1	A2L	A1	A1	A1	A2L	A1	A2L
Temperature Glide	☺	0,7	☺	☺	☺	☺	4 - 6 K	6 – 11 K	~3K	8 - 13 K	☺	~7K
Efficiency	😐	😐	☺	☺	☹	😐	😐	😐	😐	😐	😐	😐
Refrigerant Cost	Increasing	Increasing	☺	☺	☺	☹	☹	☹	☹	☹	☹	☹
		R125 (44%) R143a (52% R134a (4%)					R32 (26%) R125 (26%) R134a (21%) R1234ze (7%) **R1234yf** (20%)	R32 (24%) R125 (25%) R134a (26%) **R1234yf** (25%)	R32 (11%) R125 (59%) **R1234yf** (30%)	**R1234yf** (75,5%) R32 (21,5%) R744 (3%)	**R1234yf** (56%) R134a (44%)	**R1234yf** (78,5%) R32 (21,5%)

Secop Vision

Hydrocarbons represent the best, long term solution in low/medium pressures

The “near future expected legislation changes” will remove part of existing road blocks related to charge limits

Compressor Industry Already Prepared

- Secop produces R600a and R290 compressors since the 90‘s

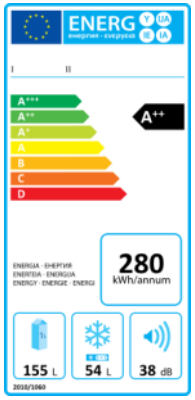
- Millions of units sold around the world: flammability can be handled with very low risk

Light Commercial Applications are on the Way

- Flammability to be addressed by IEC 60335-2-89
- Max refrigerant charge limit increase to 500 gr
- Probable approval in 2018

Variable Speed Compressors

Efficiency Labelling - Global Initiative



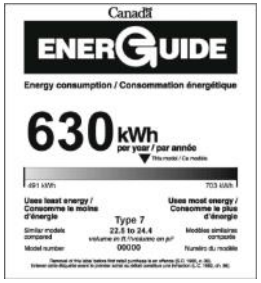
Europe

China

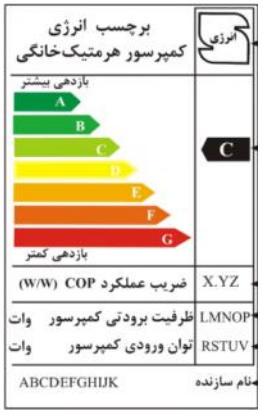
Australia

Japan

USA



Canada



Iran

Increasing energy efficiency levels

Increasing use of variable speed compressors

Variable Speed Compressors

XV	DLV	NLV	SLVE

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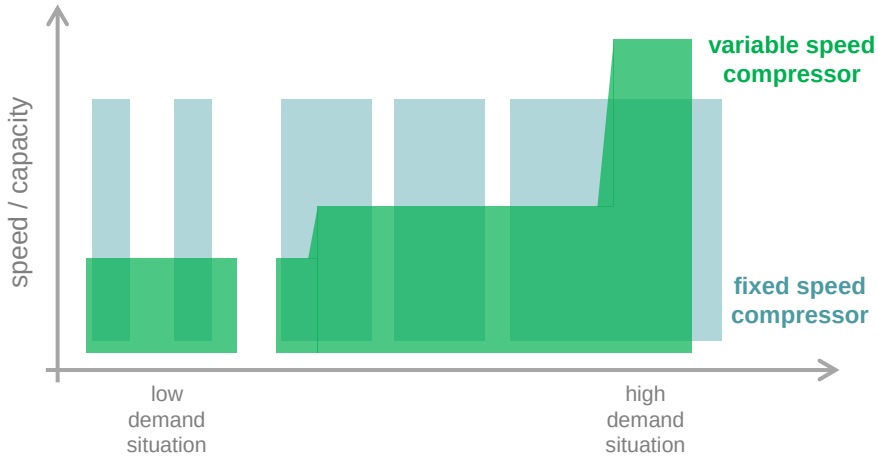
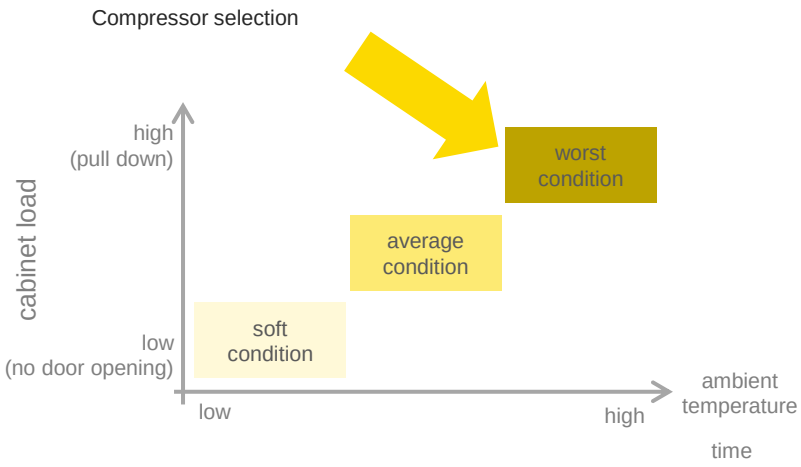
ASHRAE conditions

Higher System Efficiency

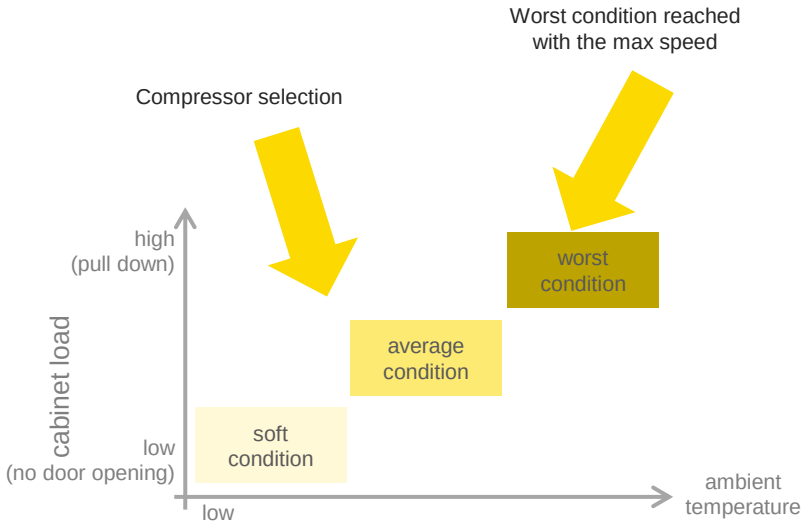


The right cooling capacity every time

Wider Capacity Range

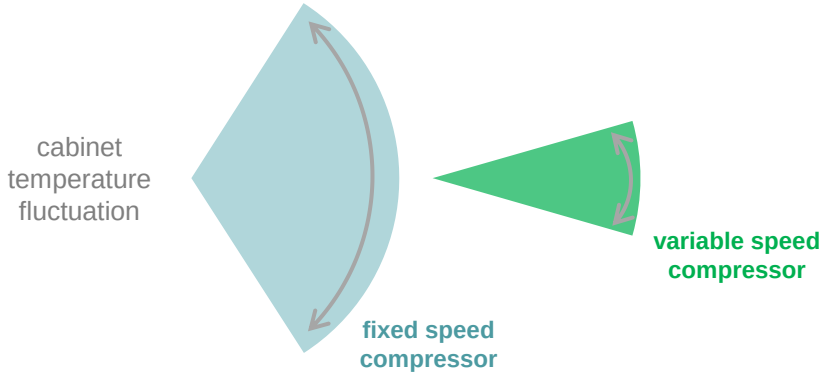


Fixed Speed



Variable Speed

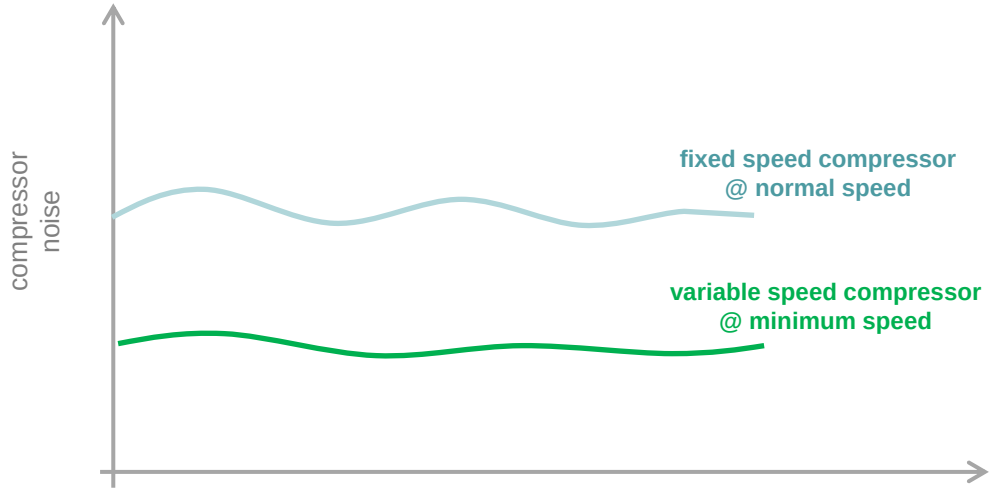
Better Temperature Control



Capacity adjustment based on temperature accuracy

Less cabinet temperature fluctuation

Lower Noise

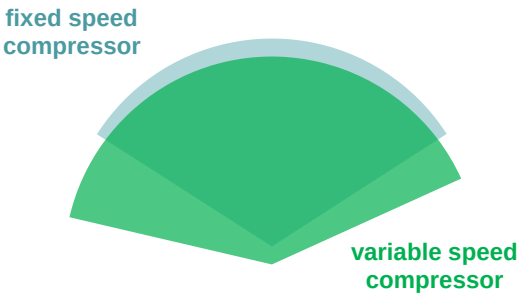


Minimum speed lower than fixed speed compressors

Longer cycles = less start & stop

Less compressor vibrations

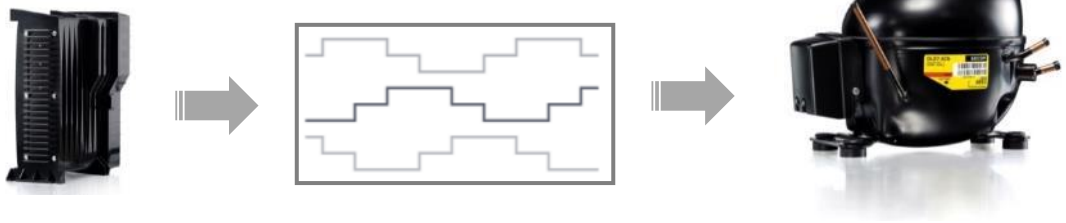
Reliable & Robust Operation



Wider voltage range

Compressor operates with voltage fluctuation (low quality electricity grids)

Reliable & Robust Operation



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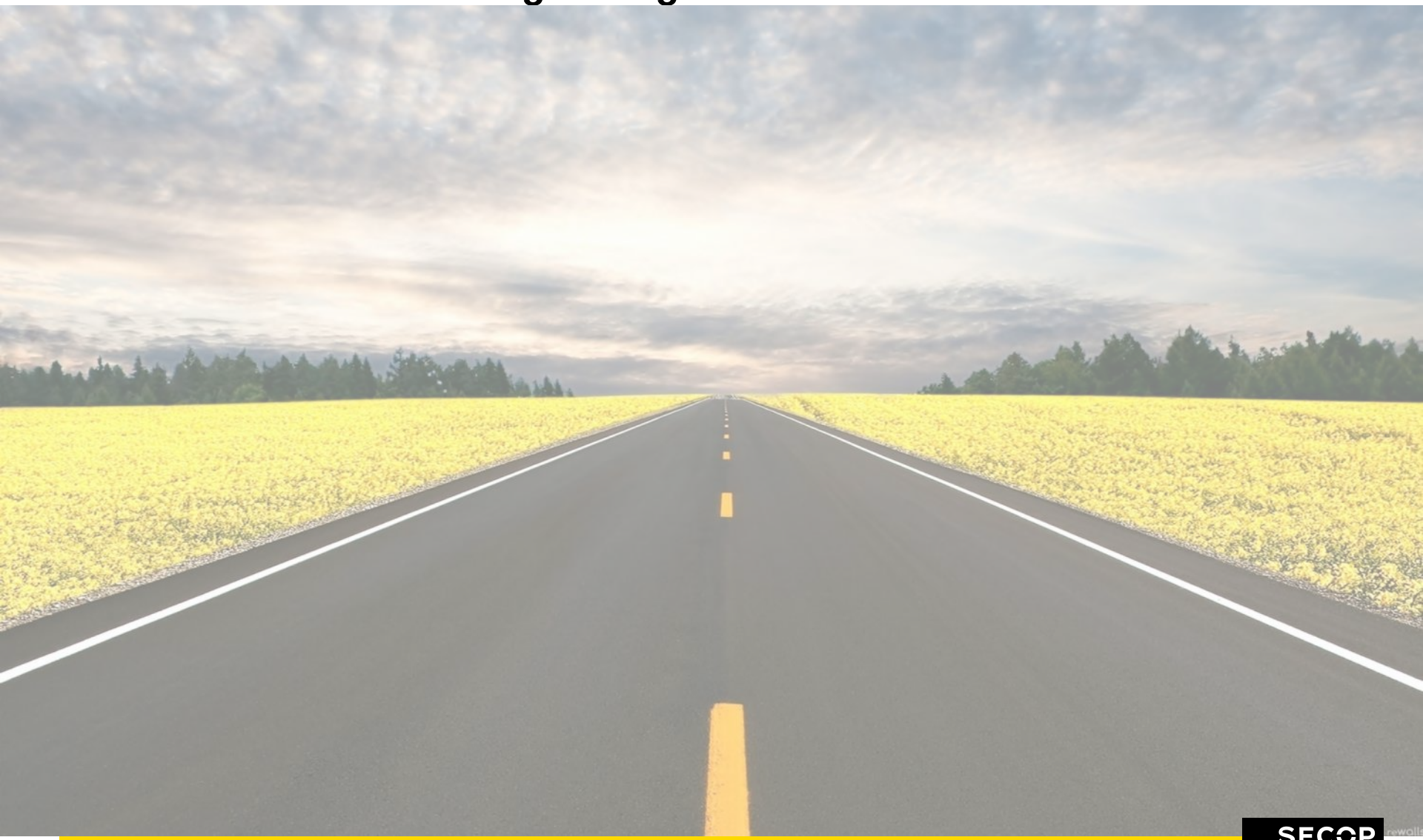
Multiple protections
increases safety / avoid compressor replacement

Future Trends in Cooling for Light Commercial



Reciprocating Compressors (Vapor Compression)

- Hermetic reciprocating compressors dominate the market because the best cost x benefit relation today

- Mature and reliable technology: developed/refined by many players during the last decades

- Next improvements:
  - Smarter algorithms in variable speed compressors
  - New materials development
  - Motor
  - Pump
  - Valves
  - Lubrication

Thermoelectric Cooling (Peltier Effect)

- Focus on small applications (low capacity)
- Low efficiency: approx. 30% less than a compressor
- No space in a scenario of more and more efficiency regulations
- Just a disruptive innovation on thermoelectric materials or construction can make the technology feasible for the mass market

Magnetic Refrigeration (Magnetocaloric Effect)

- Approx. 20% more efficient than reciprocating

- Complex construction impacting on size, weight and cost
  - Regenerators with different material configurations to achieve large temperature gradients
  - Protection of electronic components from magnetic fields

- Only disruption on magnetocaloric materials can produce a feasible system in terms of size, weight and cost

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