

Sustainable Refrigeration Summit

Connecting the Pieces for Supermarket Refrigeration Solutions



NORTH AMERICAN
**Sustainable
Refrigeration
Council**

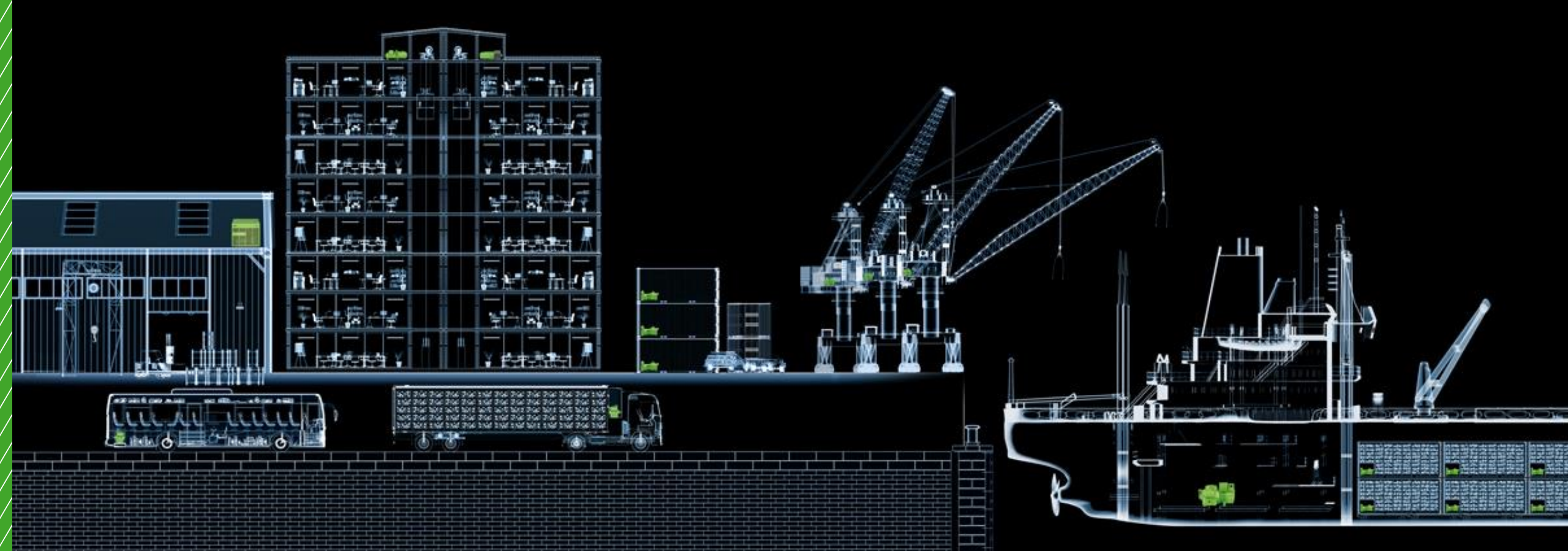
nasrc.org



Driving CO₂ Performance

BITZER US





NASRC SUSTAINABLE REFRIGERATION SUMMIT

Fall 2022
BITZER US



DAS HERZ DER FRISCHE

SYSTEM EFFICIENCY HIERARCHY



Evolution of CO₂ systems

// Cascade System

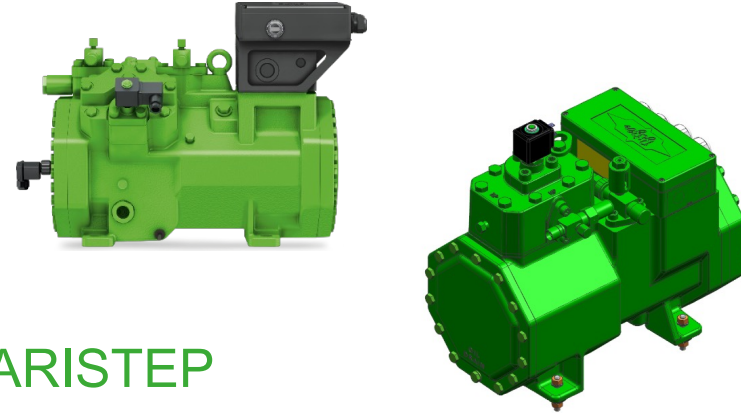
// Booster System w/FGB

– Capacity Regulation = VFD

– Capacity Regulation = **TE & SL Series w/VARISTEP**

// Booster System w/Parallel Compression

// Booster System w/**Ejectors**

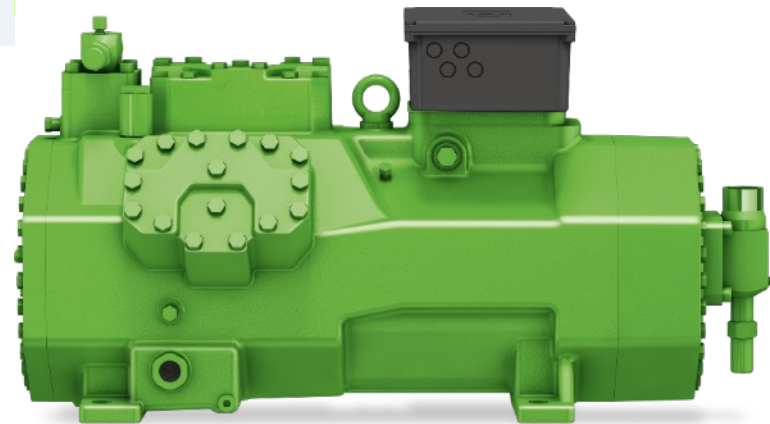


Other Design Consideration

// Integrating AC load

// Heat Reclaim

// Low Side Standstill Pressure = **ME Series**

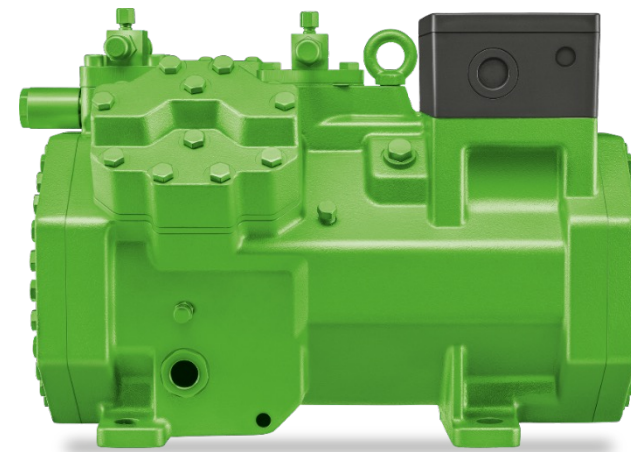
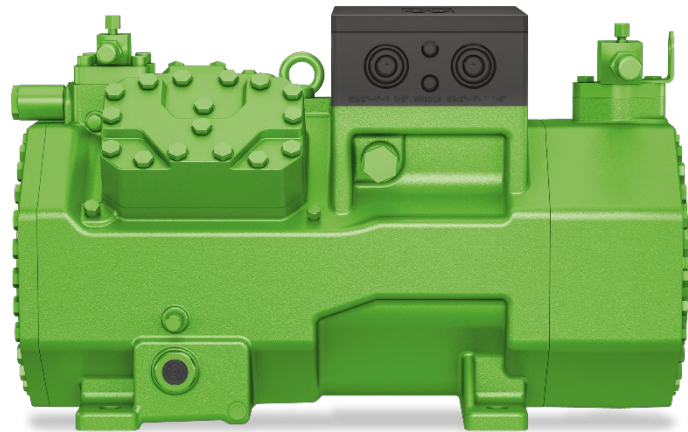


ECOLINE TE RELEASED



Benefits

- / Higher efficiency (2-4%)
- / Lower gas pulsation
- / Lower oil carry over rate
- / VARISTEP w/CM-RC
- / Expanded product offering



Updates

- / Cylinder Heads
- / Valve plates
- / Housing
- / T-Box (CKHE3)
- / Drive assembly (CKHE4)
- / Same mounting and piping connections

EXPANDED ME (SUBCRITICAL) SERIES



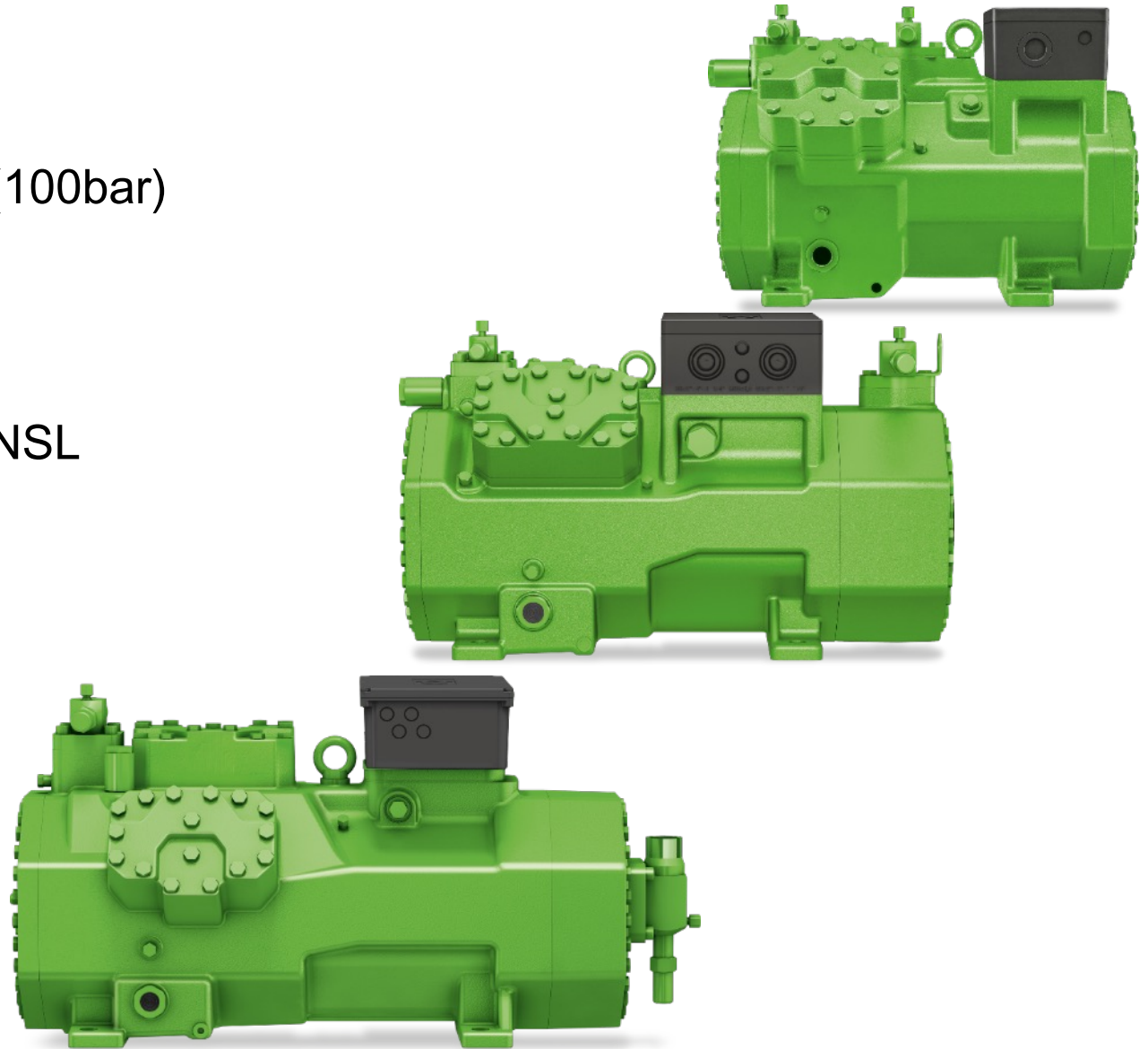
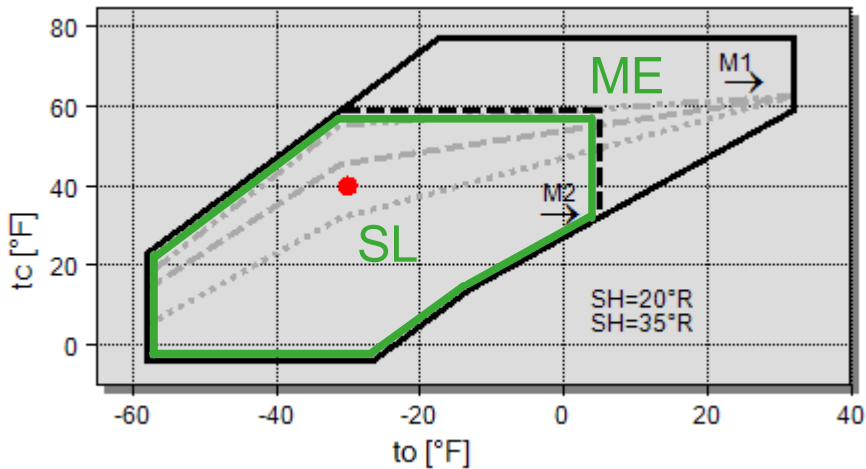
Medium & low temperature applications

// Higher stand still pressures – 1450psi (100bar)

// Higher condensing temperatures

– Motor 1 Option

// 6PME 40% > Displacement than the 4NSL

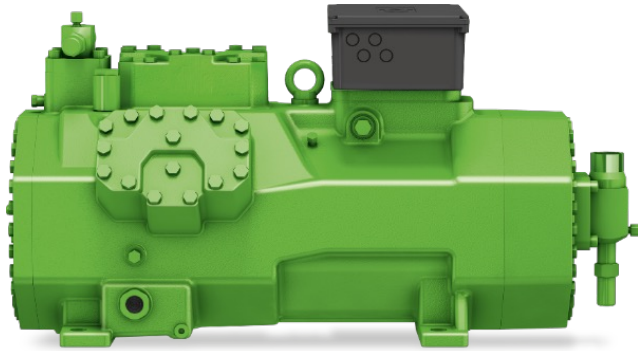


ME SERIES COMPRESSORS



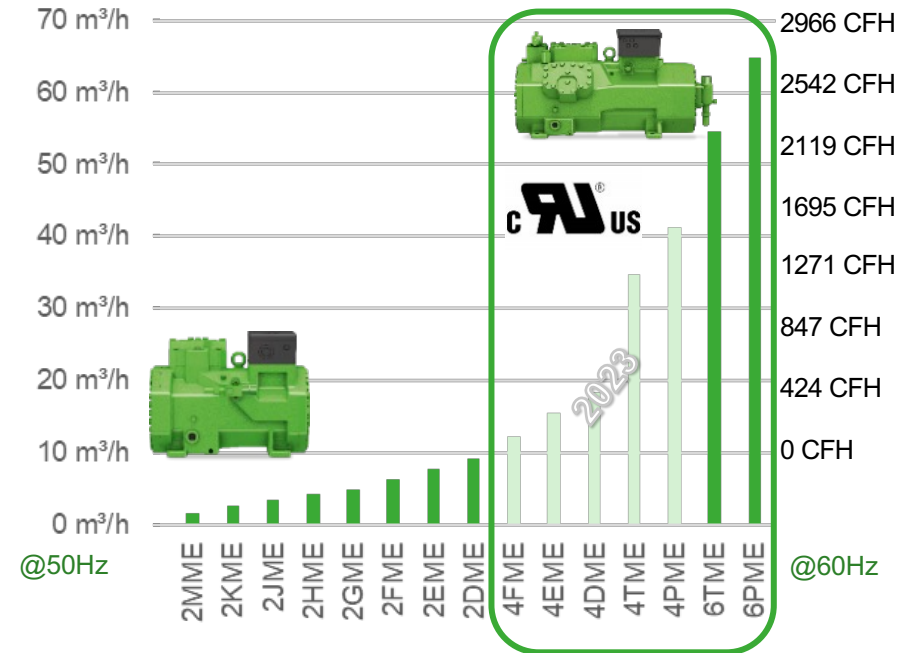
RECIPROCATING COMPRESSORS

FREQUENCY INVERTER



Benefits

- // 7 New Displacement (up to 2766 CFH)
- // Low side design flexibility
 - Elimination of back up condensing unit
- // No more Transcritical compressors on the low side
 - ME has higher displacement
 - ME has lower electrical requirement
 - ME is more efficient than TE used for Subcritical

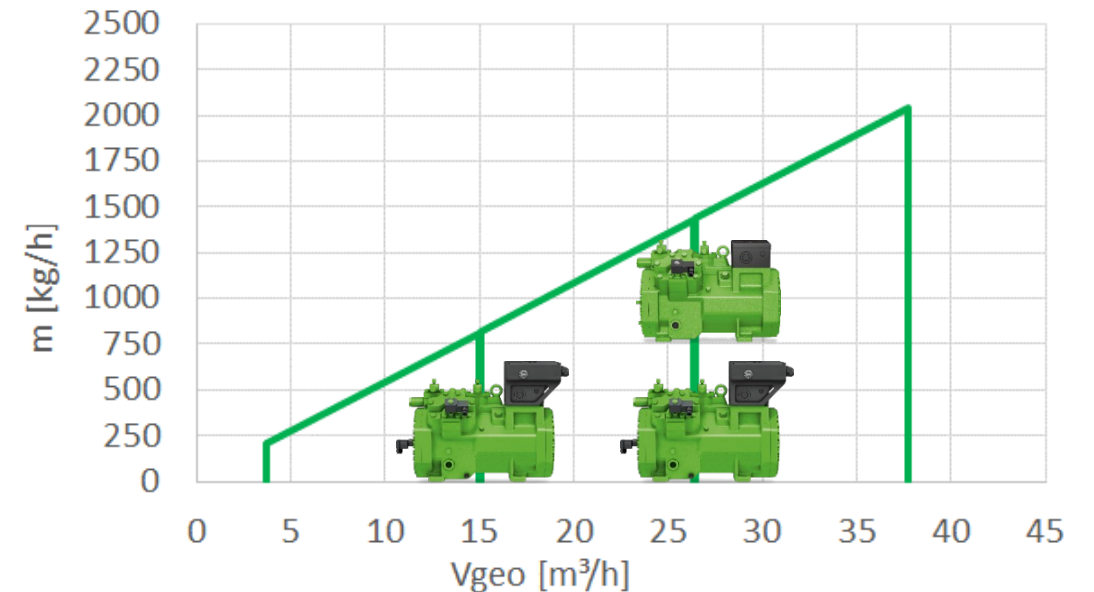
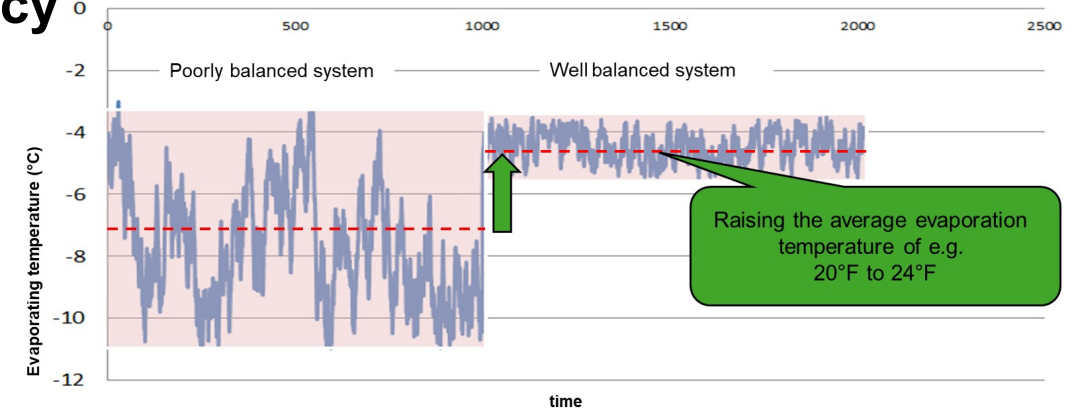


VARISTEP MOTIVATION



Alternative to a VFD to increase part load efficiency

- // Lower minimum load limit
 - 10% versus 25Hz (42%)
- // Lower cost
- // Lower complexity w/CM-RC module
 - Short list of intuitive parameter settings
 - 0-10v signal required
- // Increase staging option / compressor selection
 - Comp 1 & 2 w/VARISTEP
 - Comp 1 w/VFD, Comp 2 w/VARISTEP



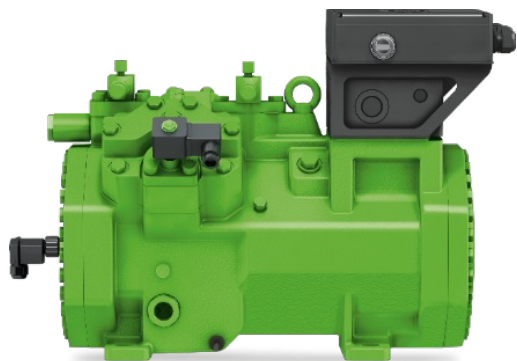
VARISTEP FOR TE (TRANSCRITICAL) SERIES



- // TE Series compressors – 12 Models
- // Controlled by standard CM-RC
 - Same Functionality, Different accessories for HP
- // Not compatible with for TC Series

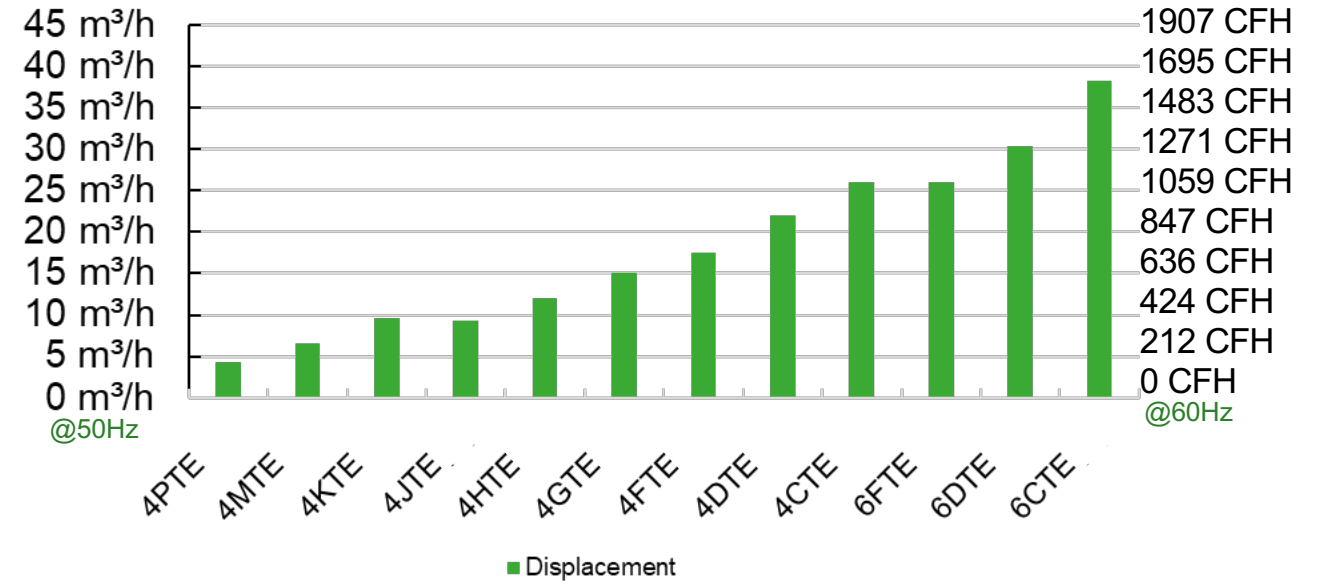


CO₂ VARISTEP



With IQ MODULE
Quasi stepless CR
 / 4 Cylinder 10-100%
 / 6 Cylinder 33-100%

ECOLINE CO₂

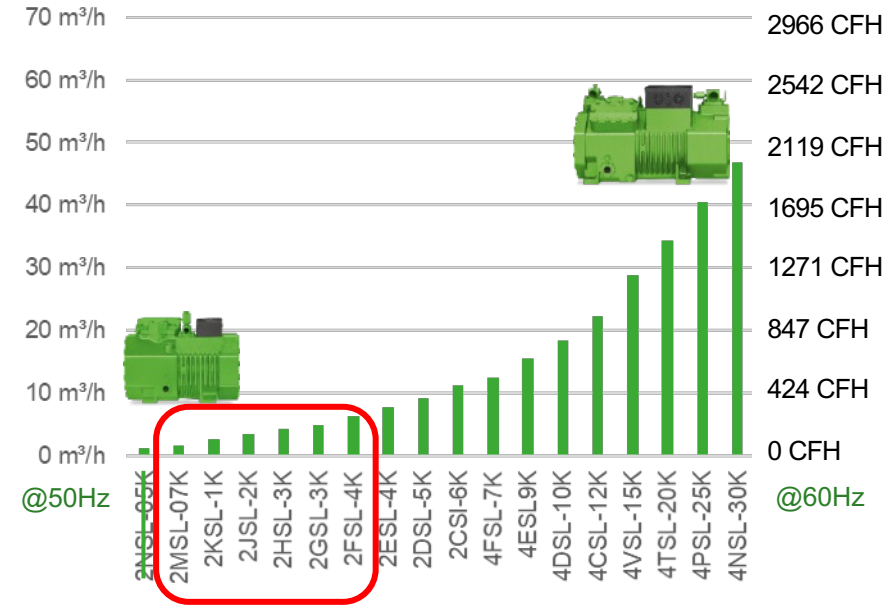
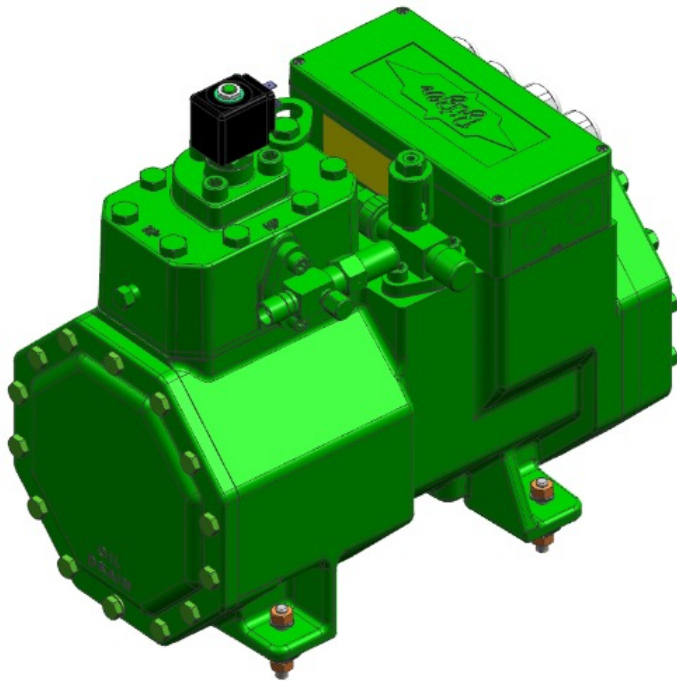


VARISTEP FOR SL (SUBCRITICAL) SERIES



Benefits

- / Alternative to VFD
- / Field Retrofittable



Notes

- / 2 Cylinder SL models (6)
 - 2MSL – 2FSL (69 – 271 CFH)
- / UL Approved
- / CM-RC available for control

EJECTORS



What is an Ejector

// A very finely adjustable high pressure control element

// A jet pump

How does it work?

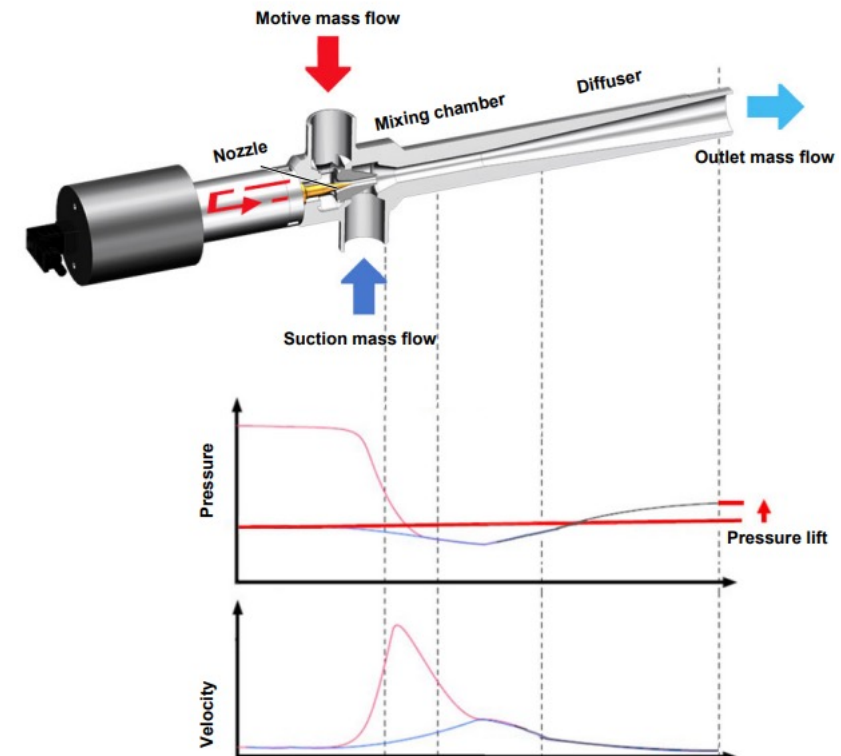
// Read BITZER Application Guide AT-744 Sec 2.2

// It involves ...

- Pressure, velocity, potential/kinetic energy, venturi principle

To create pressure lift ...

- Higher suction pressure to the compressors increases efficiency and capacity

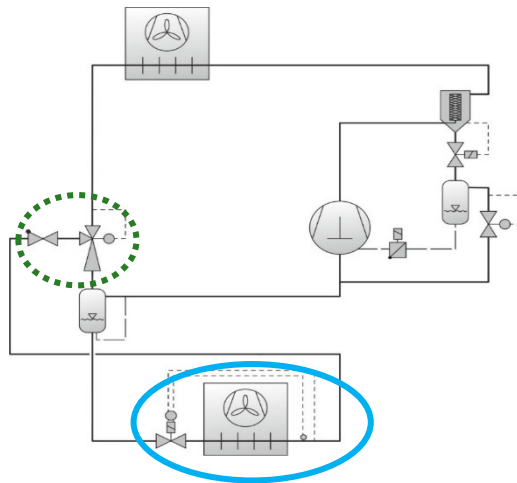


LOW LIFT VERSUS HIGH LIFT APPLICATIONS



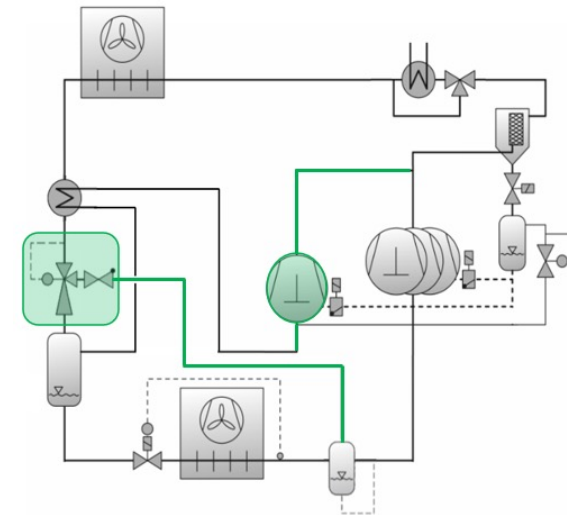
Low Lift Ejector

- // Lower pressure lift
- // Liquid and gas
- // Entraines entire evaporator mass flow
 - Higher entrainment
- // Single compressor stage



High Lift Ejector

- // Higher pressure lift
- // Preferably gas
- // Entraines partial entire evaporator mass flow
 - Lower entrainment
- // Parallel compressor stage



TYPICAL SUPERMARKET APPLICATION



- High Lift Ejector
- // Booster system
- // Parallel Compression

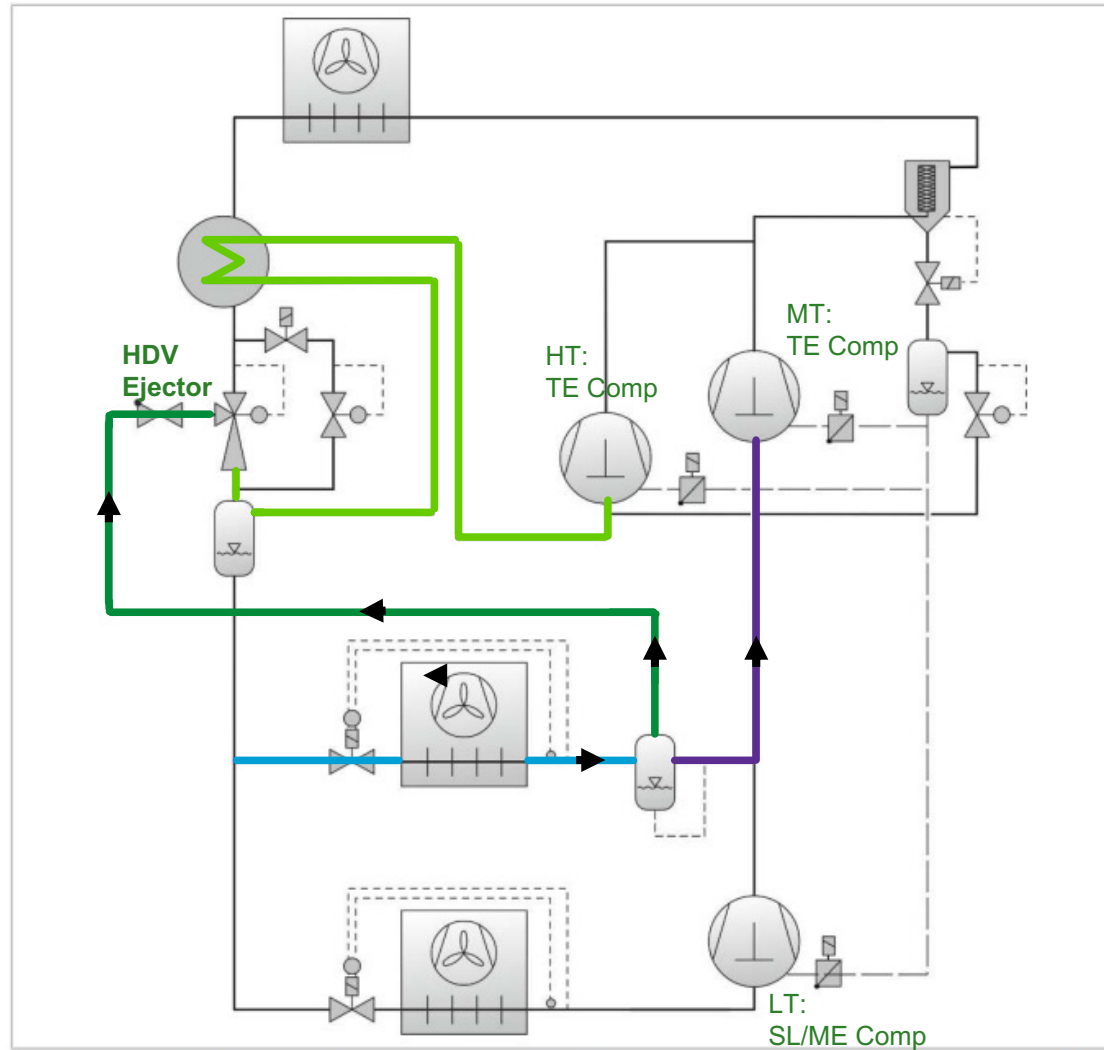
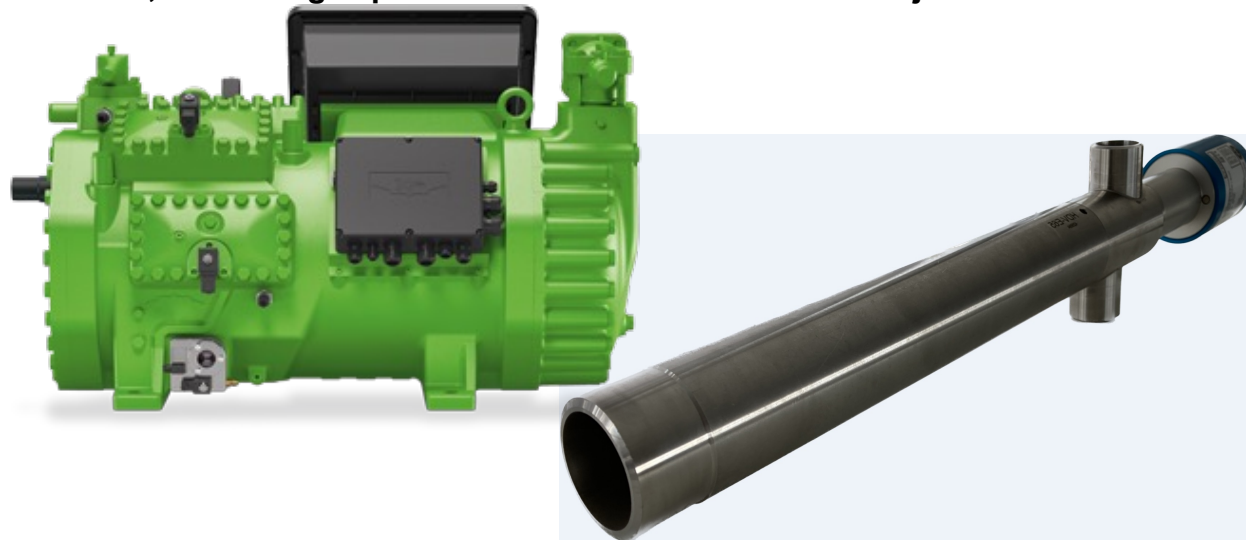


Fig. 9: System design B: with ejector, parallel compression and mechanical high-pressure control valve for emergency operation (simplified representation)

→ Seven years of experience with more than 6.5 million operating hours

Model	t _{in} * [°C]	pHP [bara]	t _o [°C]	Toh [K]	Lift [bar]	ER [-]	Qo [kW]**	m _M *** [kg]	m _{suc} [kg/h]***
HDV-E08	31	92	-4	5	5	0,446	23,7	807,9	360,3
HDV-E16	31	92	-4	5	5	0,461	48,1	1583,5	730,1
HDV-E23	31	92	-4	5	5	0,439	68,7	2374,2	1043,5
HDV-E30	31	92	-4	5	5	0,440	89,2	3079,5	1354,3
HDV-E45	31	92	-4	5	5	0,421	125,8	4541,0	1909,8
HDV-E65	31	92	-4	5	5	0,439	190,9	6595,0	2897,8
HDV-E95	31	92	-4	5	5	0,429	286,4	10137,5	4346,8

** , *** cooling capacities and mass flows based on ejector calculation model July 2022



// HDV-E95 designed to match with 8CTE-140K
(Qo 980kBtuh = 5.4 x 4FTE-30K)

Benefits

- // Integrated into BITZER Software
- // Variable Geometry
- // High Efficiency over a wide range
- // Optimal adaptation to load variations
- // Wide product range
 - 7 models (80 – 980 kBtuh)
 - Larger capacity in parallel

8 CYLINDER CO₂ TRANSCRITICAL RECIP



8 CYLINDER CO₂ TRANSCRITICAL COMPRESSOR



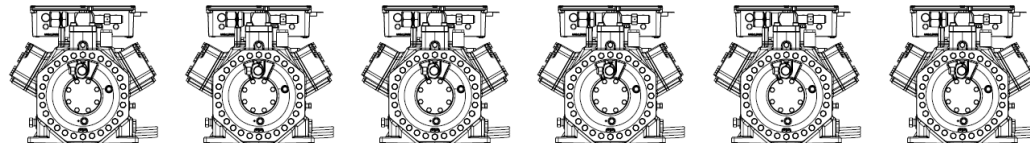
IQ MODULE

RECIPROCATING COMPRESSORS

INTELLIGENT PRODUCTS

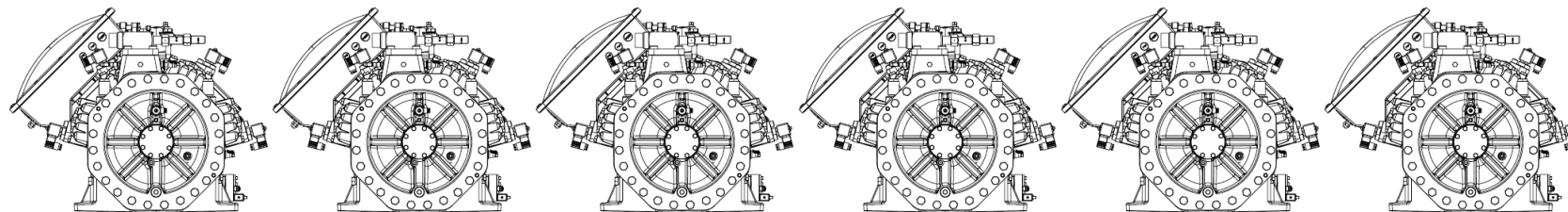
FREQUENCY INVERTER

Model	Displacement CFH @ 60Hz	Displacement m ³ /h @ 50Hz	Motor Version
8FTE-100K	2925	69.4	2
8FTE-140K	2925	69.4	1
8CTE-140K	4204	99.2	2



**6CTE-50:
1628 CFH @ 60HZ**

≈ 140TR



≈ 400TR



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