



EMPIRICAL EVALUATION OF THE
ANNUAL EFFICIENCY FOR A
TRANSCRITICAL R744 BOOSTER SYSTEM
WITH PARALLEL COMPRESSION
IN ASIAN CLIMATE CONDITIONS

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Introduction



CO₂ AS A REFRIGERANT – START RIGHT AWAY!

- / During the last 15 years the natural refrigerant CO₂ has slowly emerged from a niche application to a preferred option for a low GWP solution of more and more customers in commercial refrigeration
- / BITZER compressors for sub- and for transcritical applications: More than 15 and 10 years of experience respectively
- / The revised F-Gas regulation (no. 517/2014) pushes the application of low GWP refrigerants, especially CO₂
- / Phase down requires significant reduction of average GWP! The average GWP of refrigerants used might be ≈ 2300 in 2015 and ≈ 1000 in 2021 (Including service for AC, commercial refrigeration and the consumption for MAC)
- / CO₂ as refrigerant has and further will gain momentum, especially in commercial refrigeration!

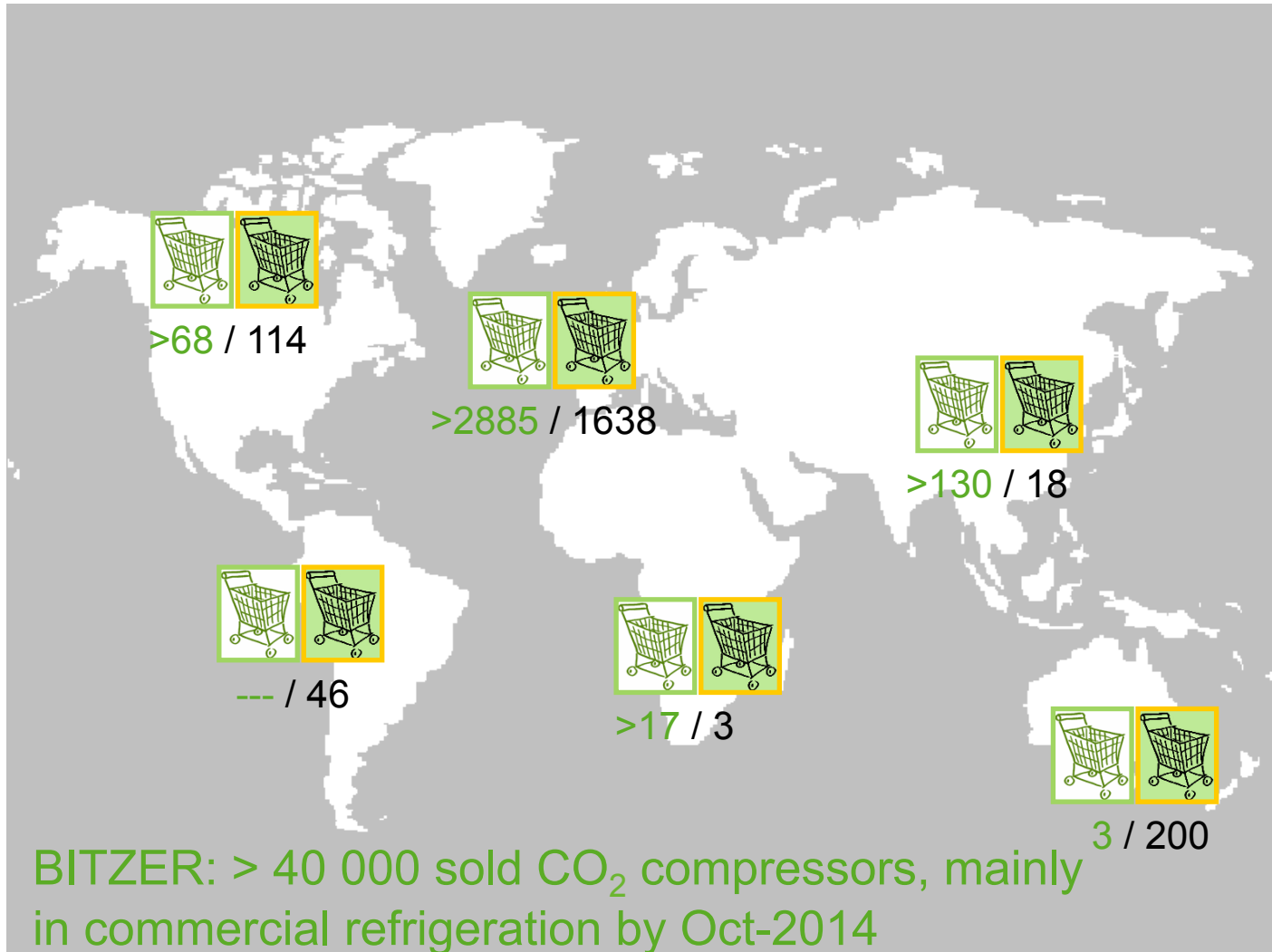
COMMERCIAL REFRIGERATION WITH CO₂: NUMBER OF INSTALLATIONS



Transcritical systems with CO₂: >3100



Subcritical systems with CO₂: >2020



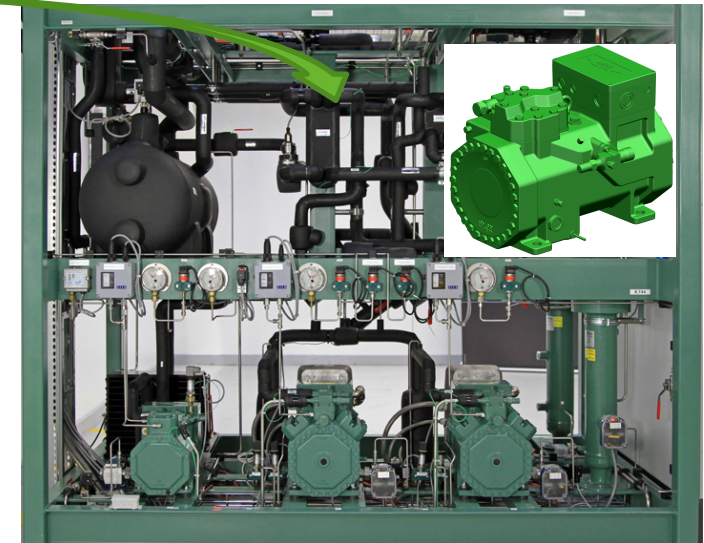
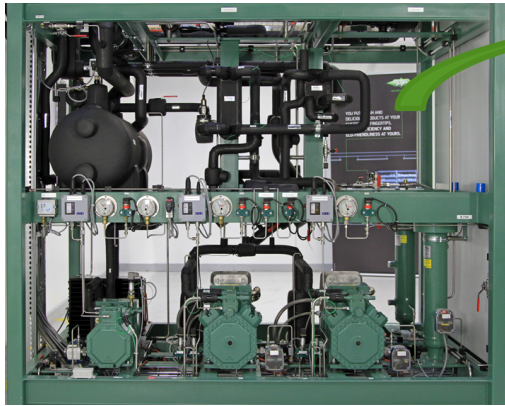
Reference: Shecco, summary report ATMOSphere Asia 2014, BITZER

Empirical study
of a CO₂ booster system with parallel
compression



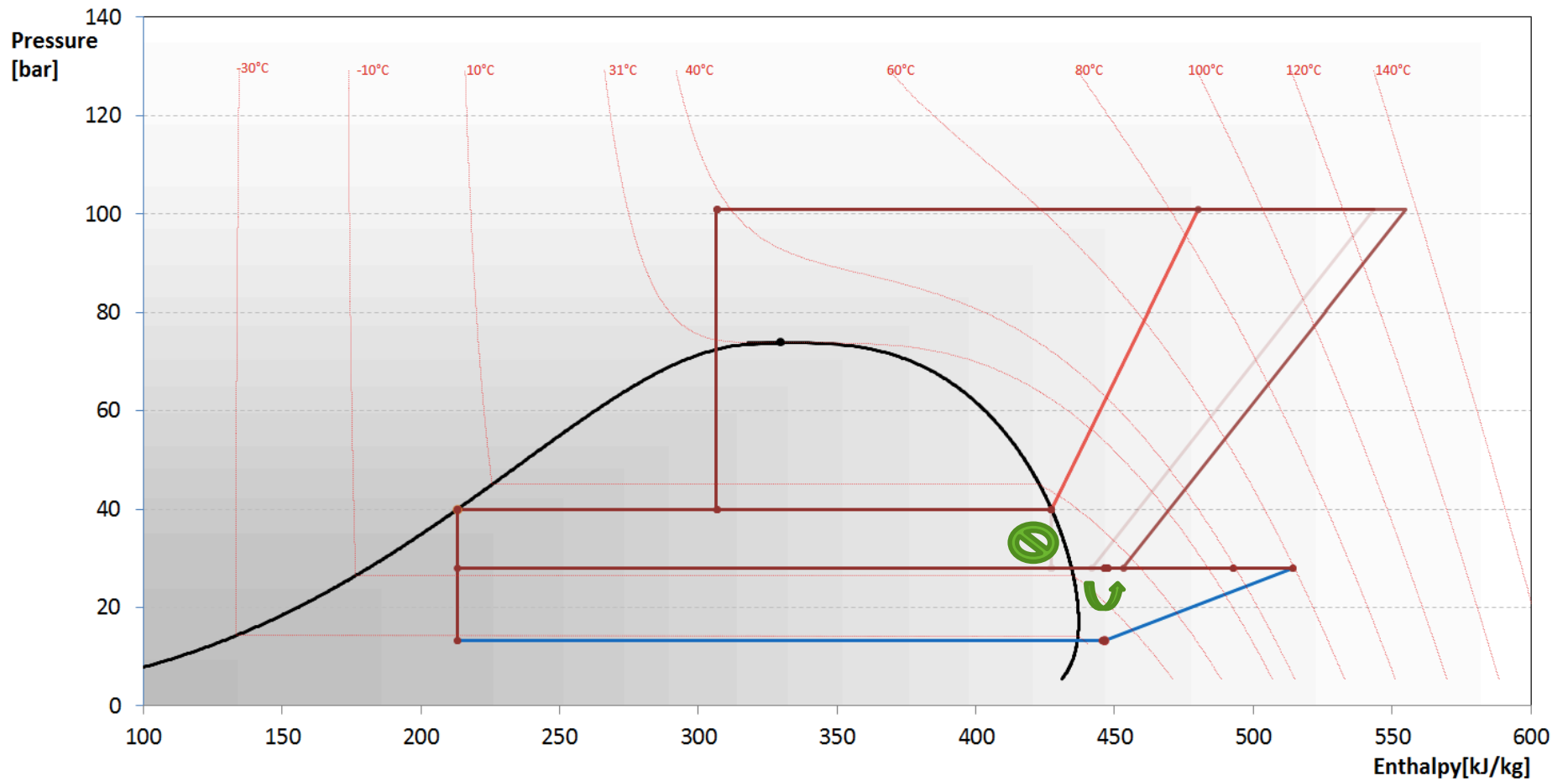
APPLIED CO₂ BOOSTER SYSTEM

BITZER 2MTE-7K: New compressor for transcritical applications

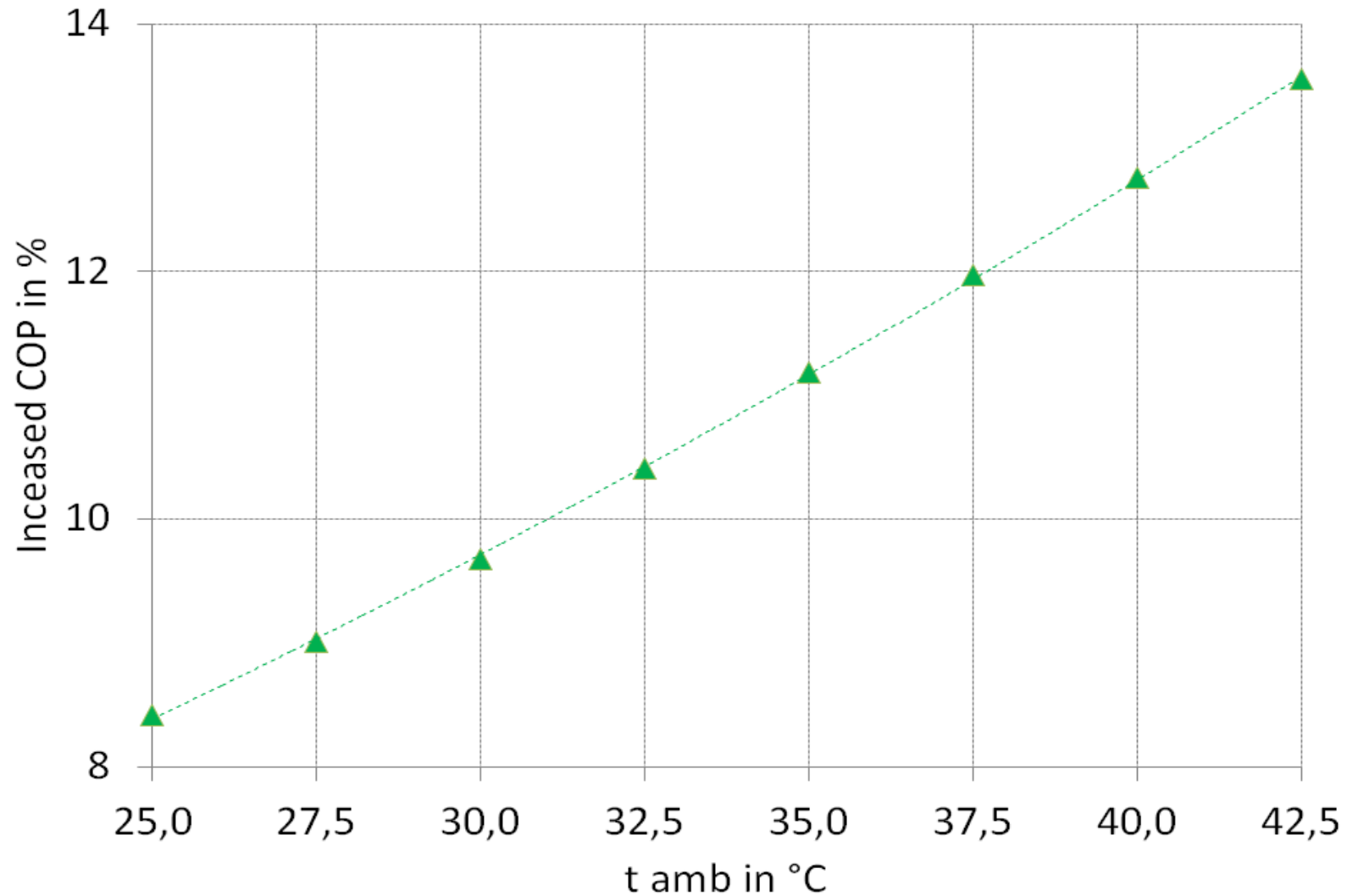


- / CO₂ booster system of the 3rd generation with parallel compression (PC) and flash gas bypass (FGB), no heat reclaim, empirical evaluation
- / 2MTE-7K as parallel compressor: Smallest compressor displacement forced change in capacity and load ratio compared to ATMOSphere 2014!
- / CO₂ booster system with flash gas bypass, which is installed by BITZER at its Rottenburg site for practical training seminars since autumn 2010, is going to be rebuild by applying the 2MTE-7K as parallel compressor

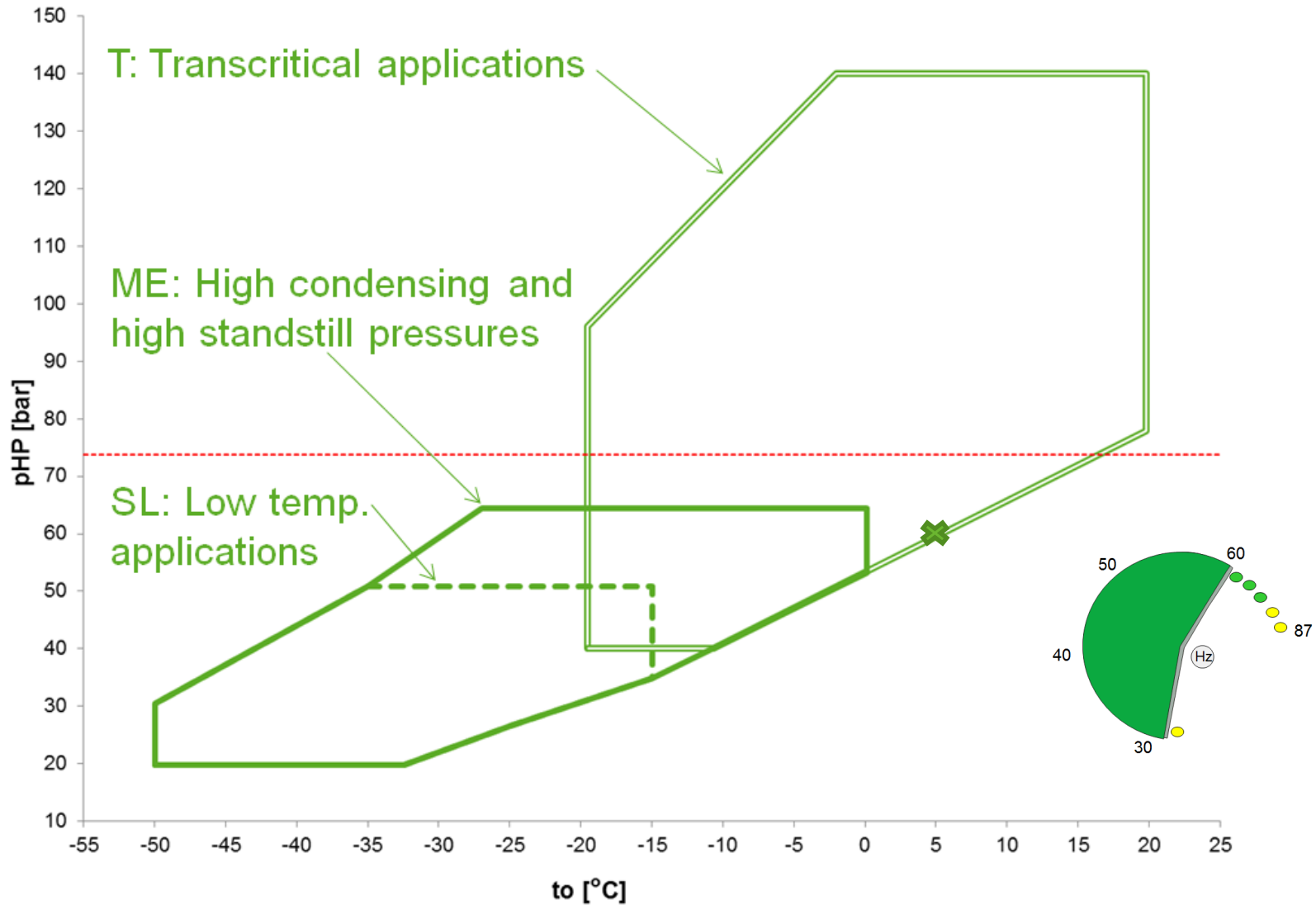
PARALLEL VS. FG - BYPASS SYSTEM



INCREASED COP WITH PARALLEL COMPRESSION FOR THE CONSIDERED SYSTEM



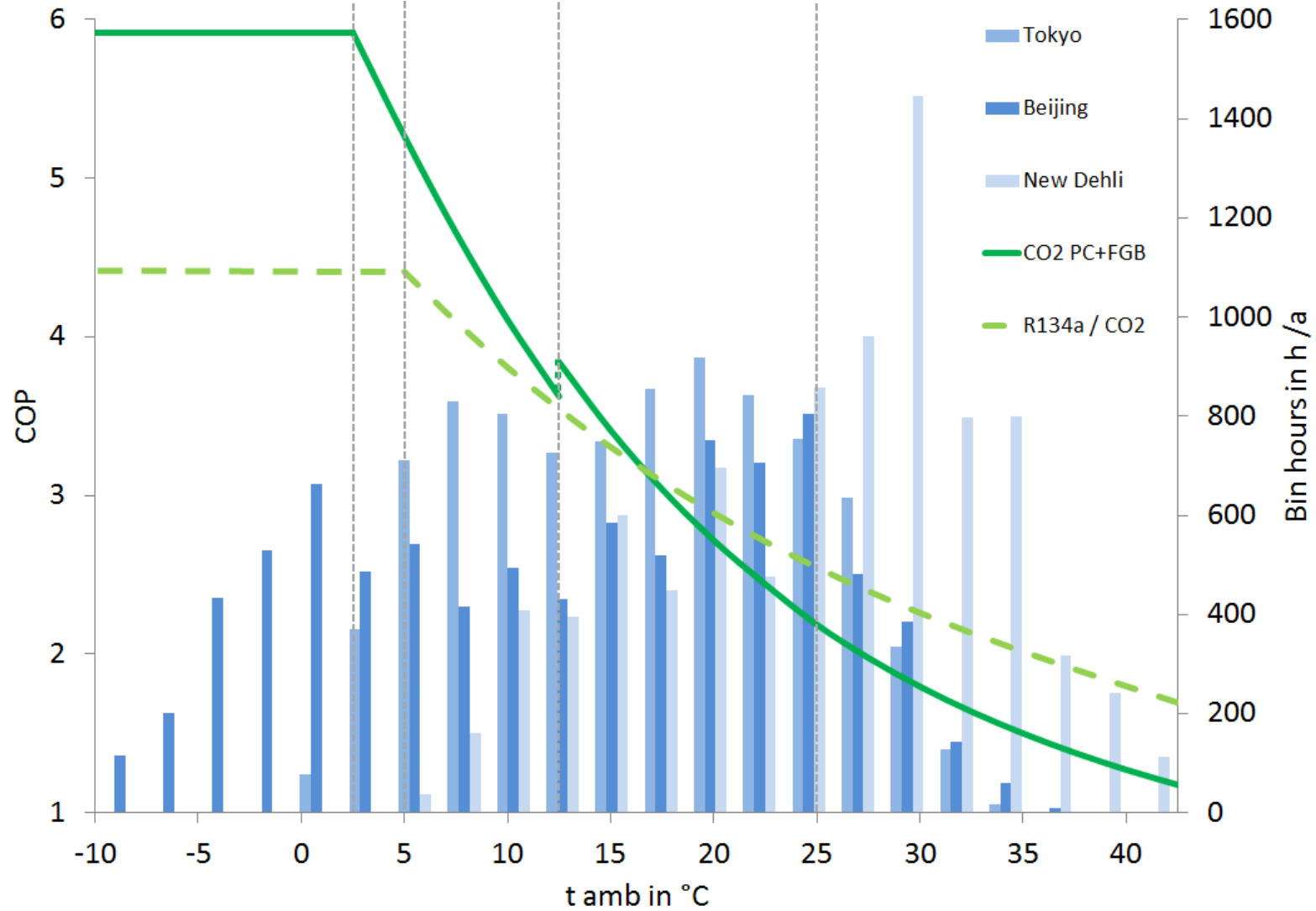
LIMITS FOR THE APPLICATION OF PARALLEL COMPRESSION



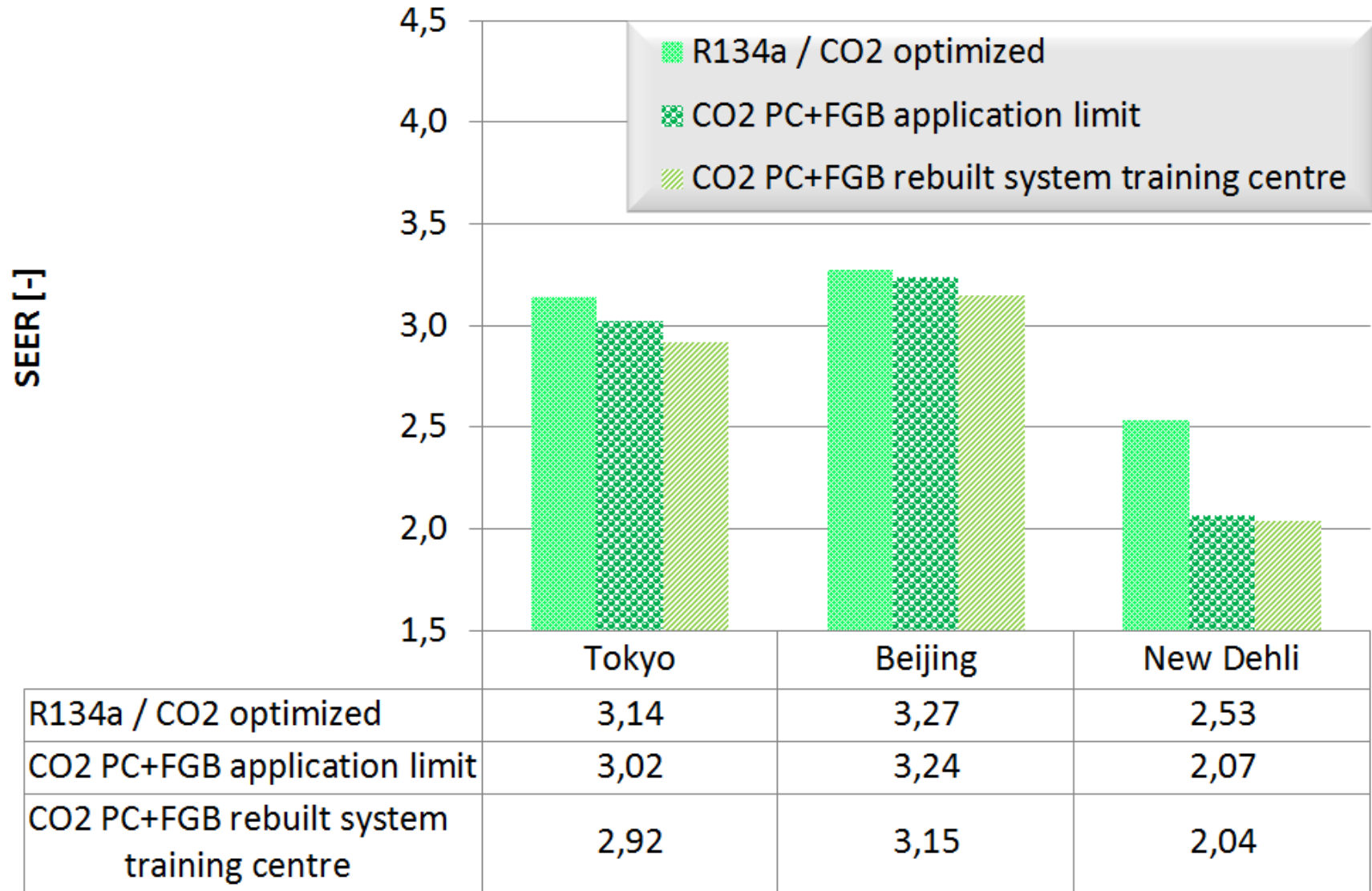
Results



COP DEPENDENT ON AMBIENT TEMPERATURE



ANNUAL ENERGY EFFICIENCY



Conclusions



CONCLUSIONS

- / Parallel compression: The increase in COP is significant!
 - Increase in COP dependent on heat sink temperature, compressor application limits, system related issues
- / Increase in annual energy efficiency is dependent on bin hours per year ($\Sigma Q_{o_i} \times h_i / \Sigma P_{e_i} \times h_i$), where parallel compression can be applied
- / Parallel compression shifts the “CO₂ equator” into warm regions!
 - Taking size of a system, combined AC and heat reclaim, pressure drops, etc. into account, results can even be further boosted!
 - Natural single fluid solution, safety group A1
- / Only in hottest climates: Optimized hybrid solutions remain as benchmark
- / BITZER provides compressors, solutions, services and trainings for all sustainable options



solutions for asia
natural refrigerants

3-5 February 2015 in Tokyo

Thank you very much!