BUILT FOR IT.

CATERPILLAR®

New Cat® Products

Power Density & Emissions

Bryan Fore – Large EP Product Definition

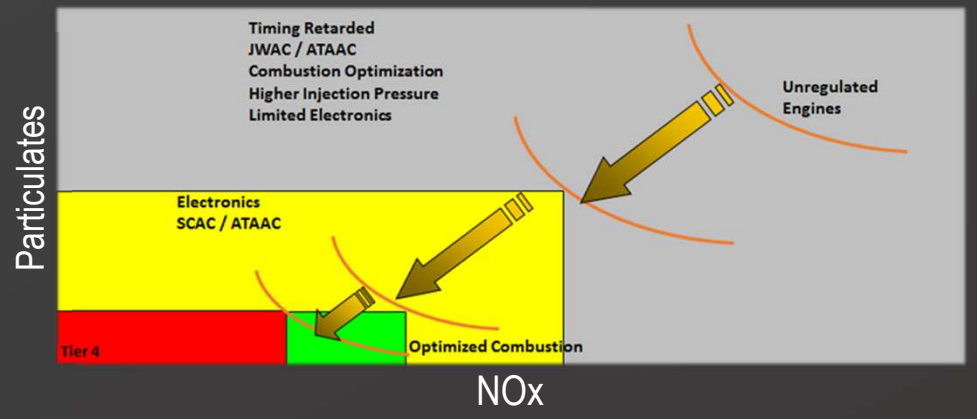
Electric Power Days - May 2017

BUILT FOR IT.

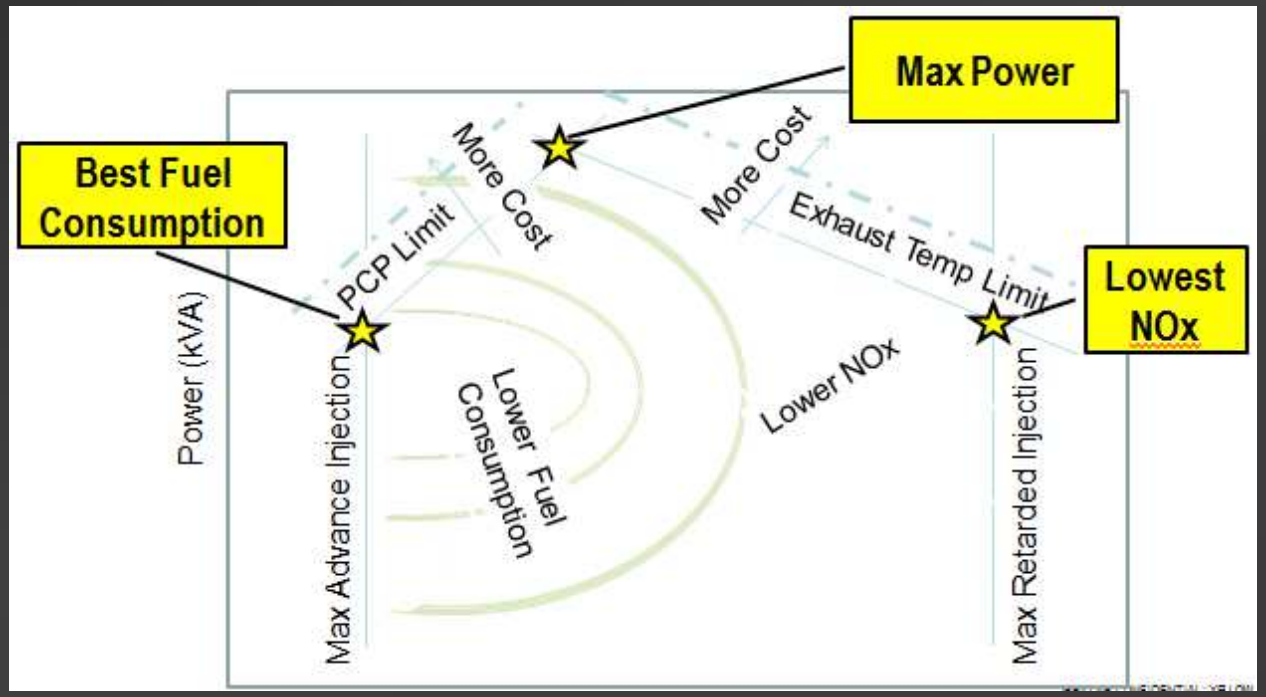
CATERPILLAR®

Generator Set Performance Journey

- Diesel genset capabilities continue to increase
- Power and Emissions improvements
- Component and electronics technologies



Performance, Cost & Emissions Balancing Act



Delivered & Installed Cost Benefits

- More power out of a smaller platform =
  - Rating optimized to requirements
  - Lower packaging cost
  - Lower transportation cost
  - Lower installation cost
  - Lower site / BOP cost (lower sqft)

Support Cost / Risk Reduction

- Cat dealer support
- Risk reduction with Cat Connect

3500 By The Numbers

Cat 3500 Engine Platform

the gold standard in high horsepower heavy-duty engines

3B
operating hours

190,000+
engines shipped since 1981

10,000+
global customers

250M HP
(170M kW)
in the field

4 *design/development locations*

2 *manufacturing locations*

4 *component manufacturing locations*

- ✓ *Electric Power*
- ✓ *Oil & Gas*
- ✓ *Marine*
- ✓ *Rail/Industrial*
- ✓ *Cat Machine*

722
global suppliers

- ✓ *Gas*
- ✓ *Diesel*
- ✓ *Dual Fuel*
- ✓ *Bio-Fuel*

1 global brand

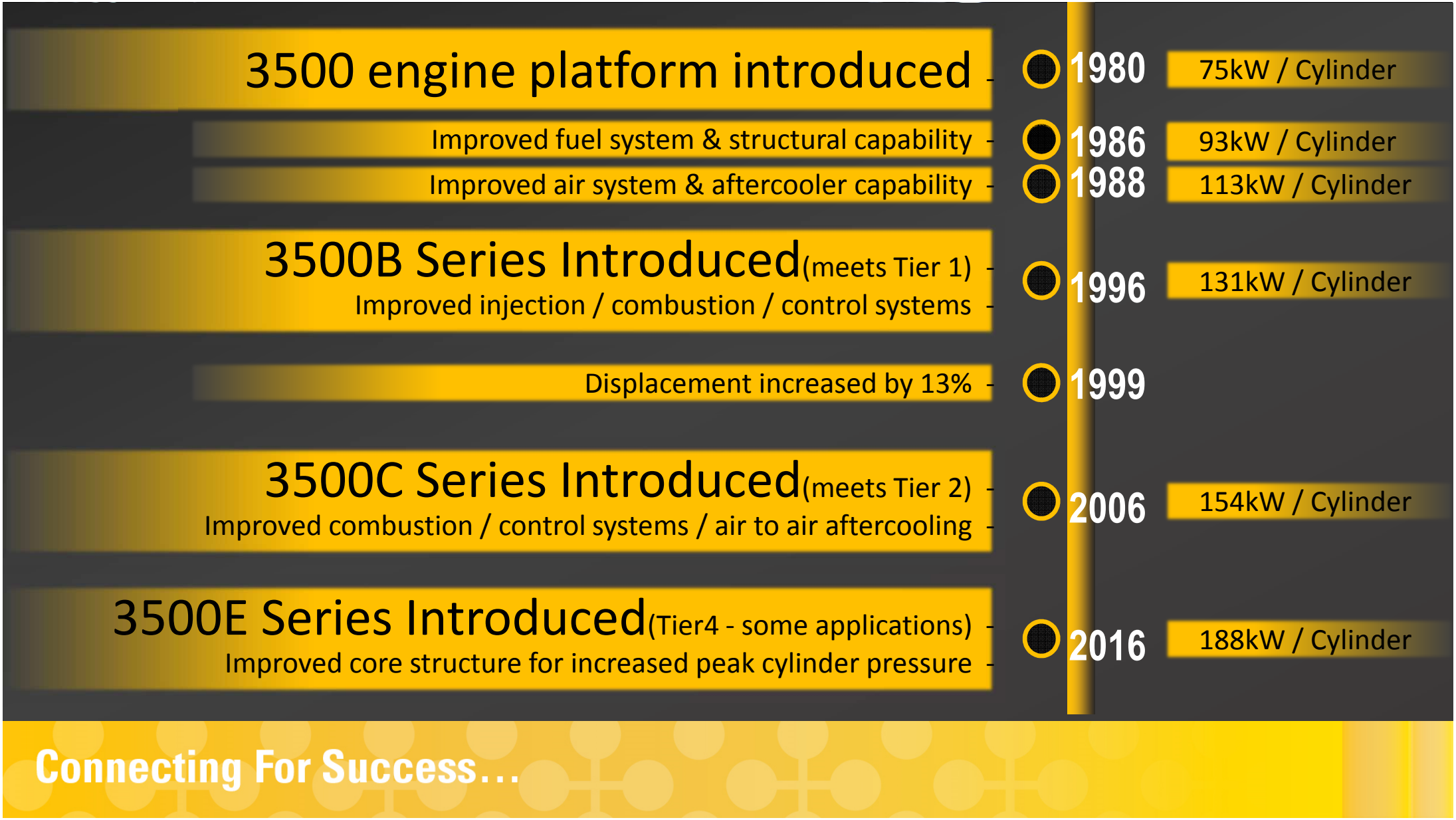
500,000+
part numbers

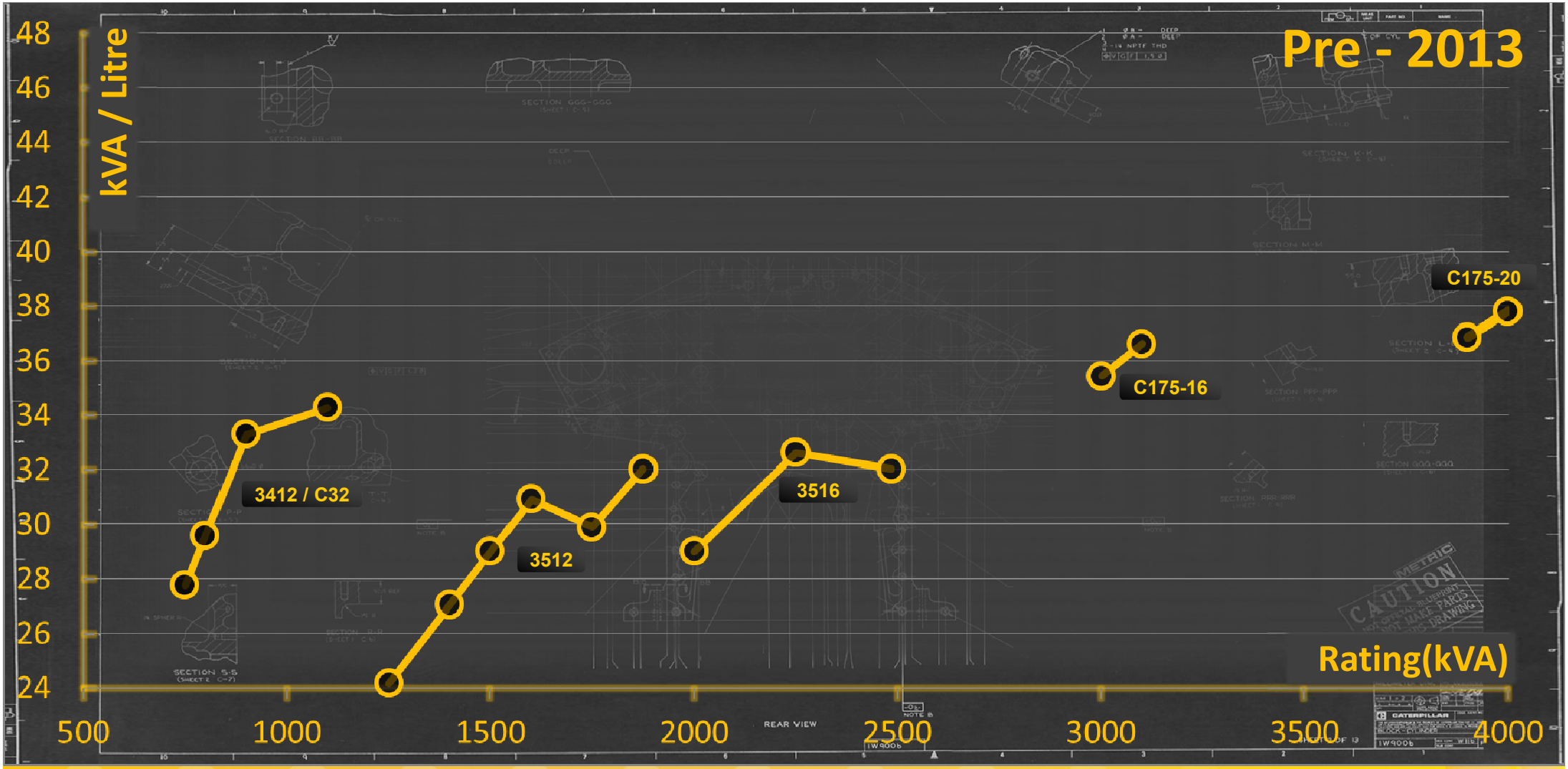
13,000+
remanufactured 3500s

500-3500 HP
391-2747 bkW power range

8, 12, 16, 20
cylinder configurations

Connecting For Success…


3500 engine platform introduced
1980
75kW / Cylinder
Improved fuel system & structural capability
1986
93kW / Cylinder
Improved air system & aftercooler capability
1988
113kW / Cylinder
3500B Series Introduced(meets Tier 1)
Improved injection / combustion / control systems
1996
131kW / Cylinder
Displacement increased by 13%
1999
3500C Series Introduced(meets Tier 2)
Improved combustion / control systems / air to air aftercooling
2006
154kW / Cylinder
3500E Series Introduced(Tier4 - some applications)
Improved core structure for increased peak cylinder pressure
2016
188kW / Cylinder
Connecting For Success…



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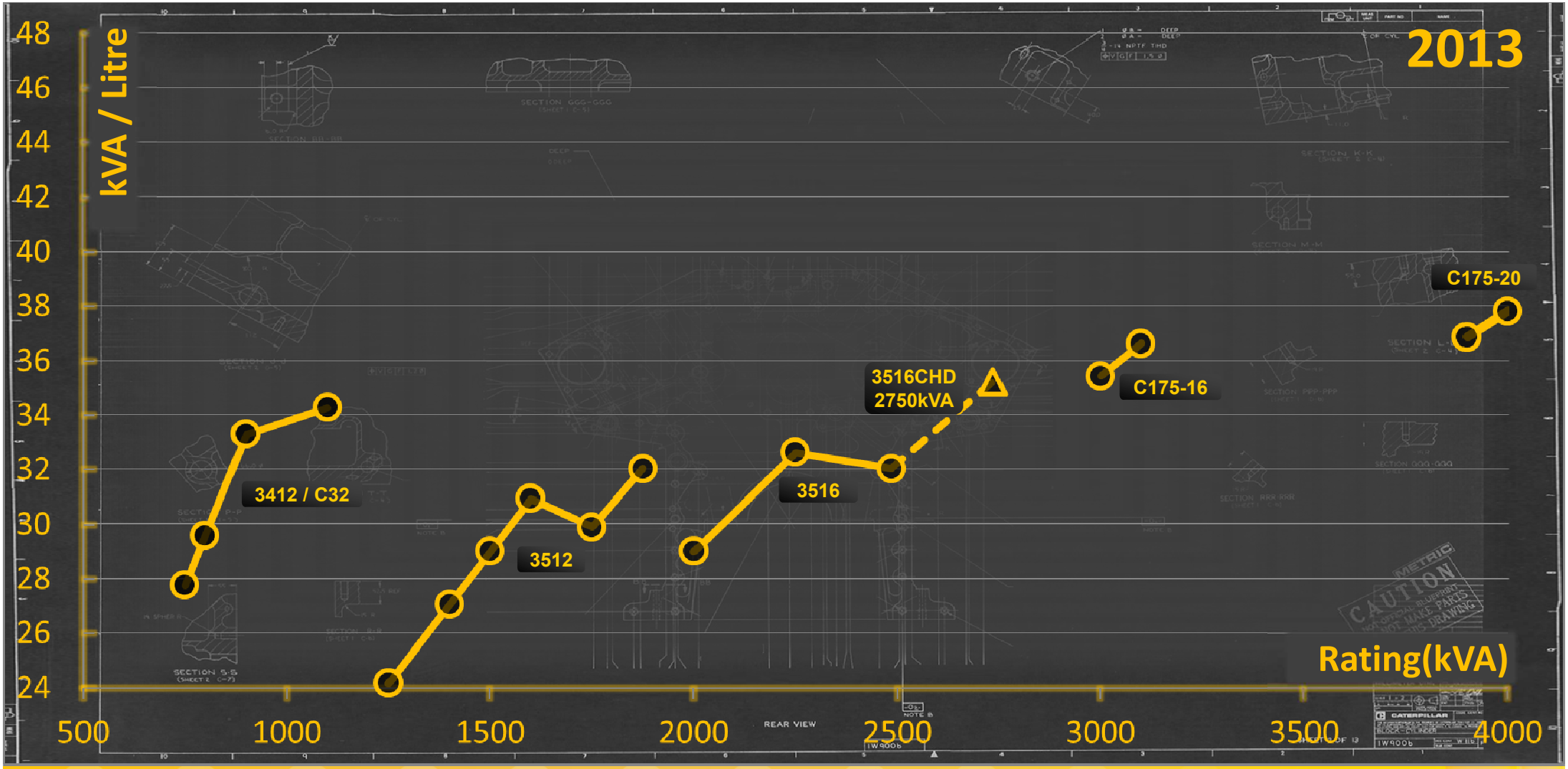

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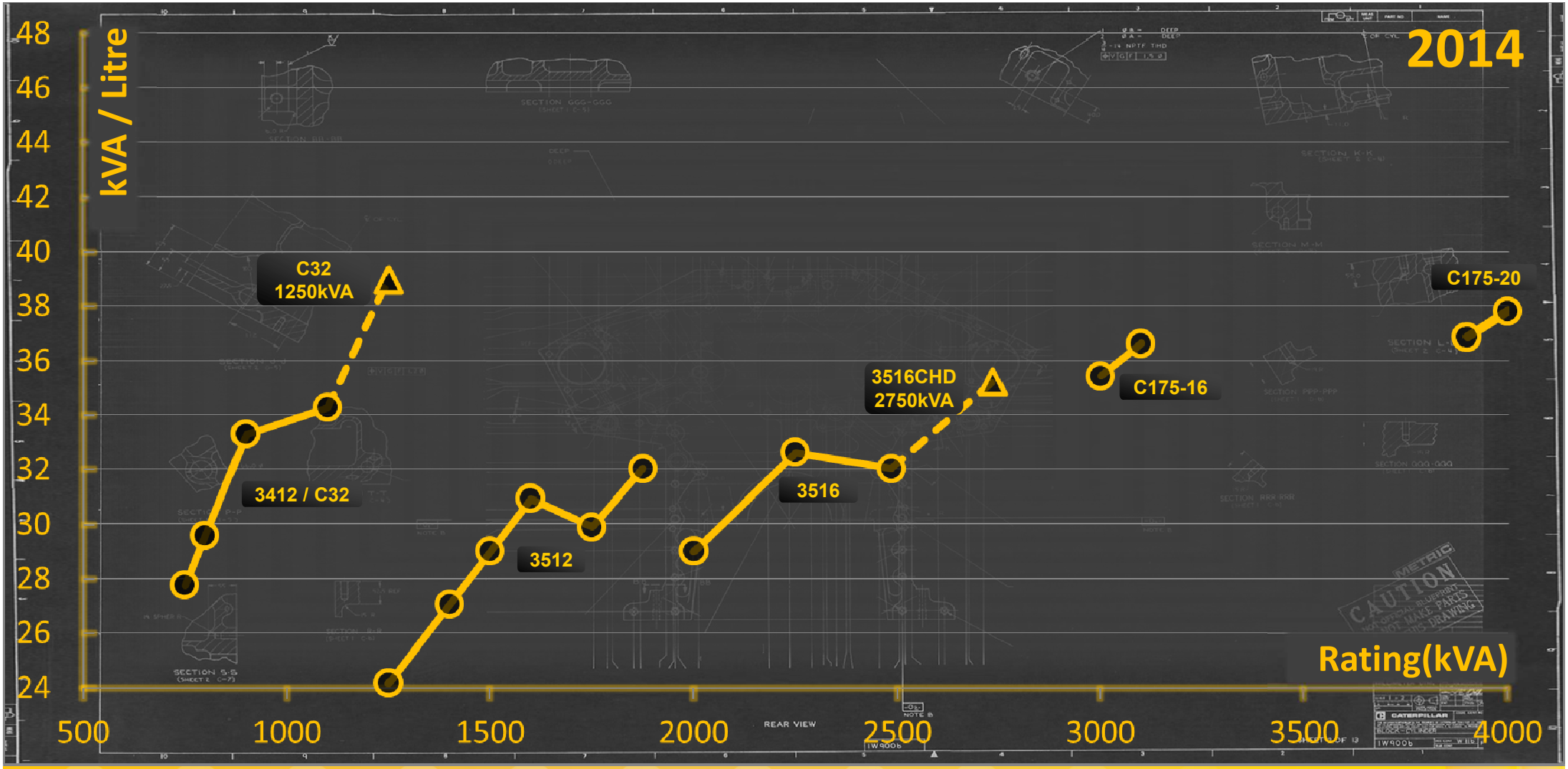

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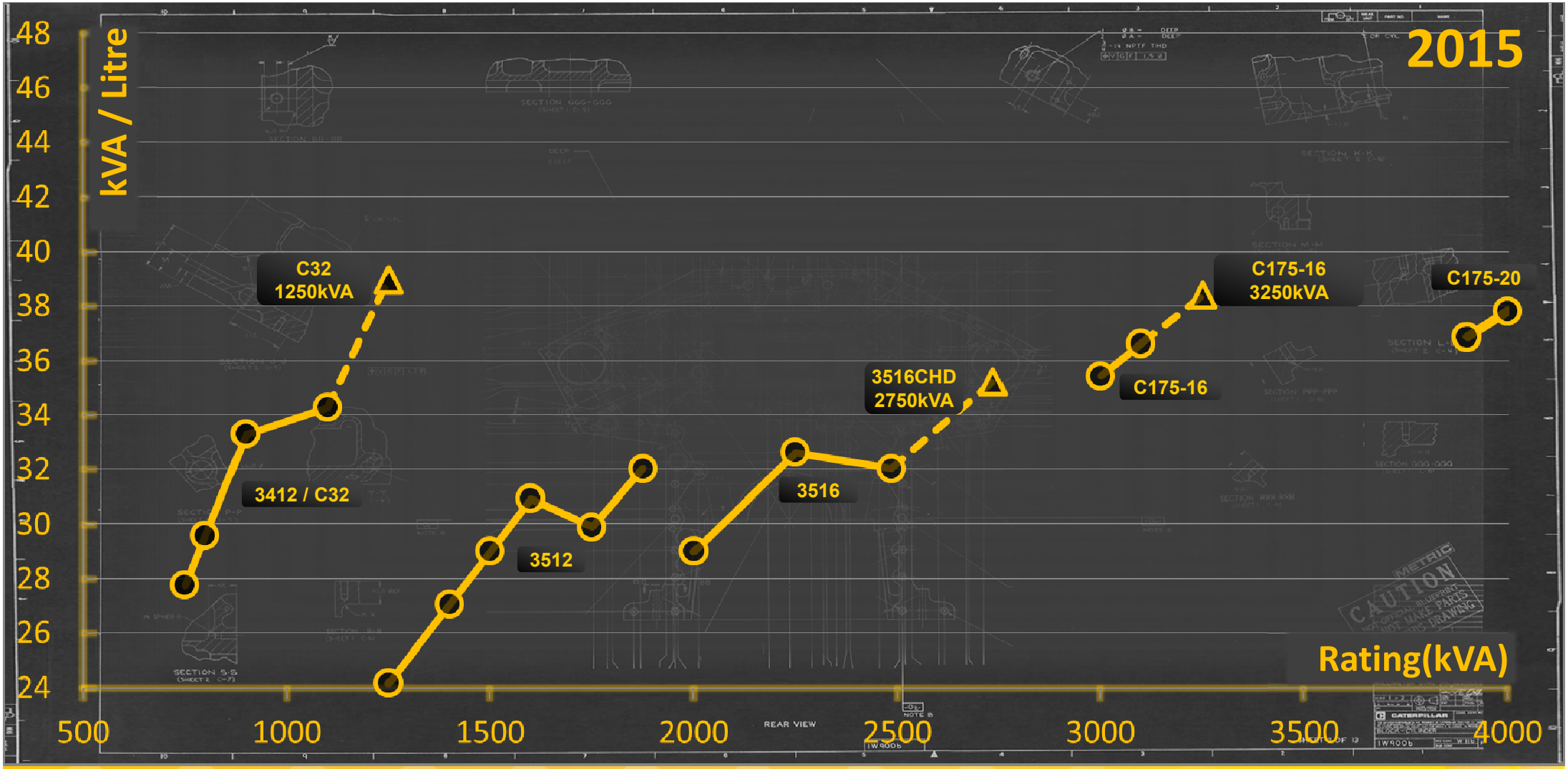

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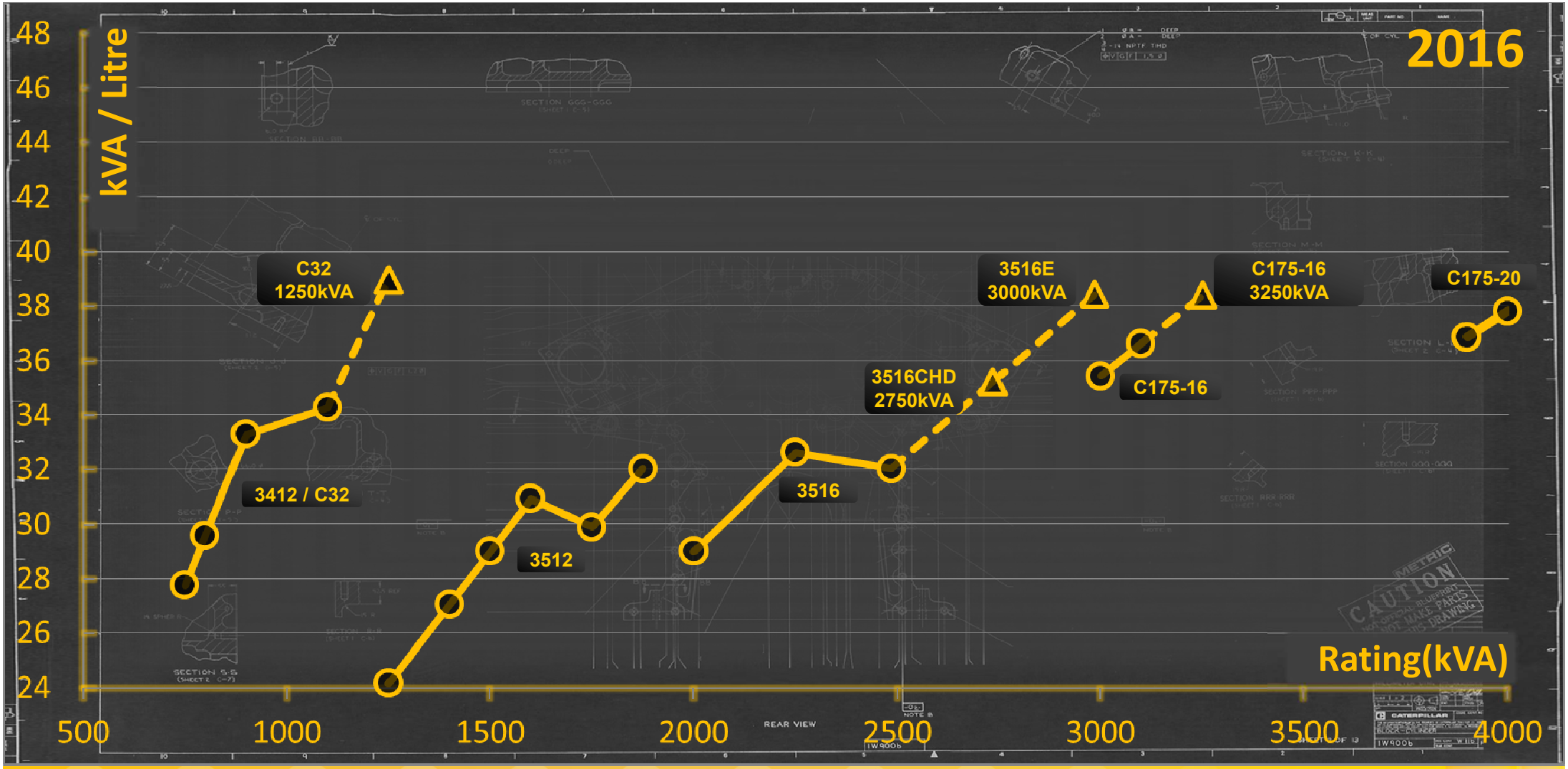


Connecting For Success…

Connecting For Success…

Cat 3516E

2750 kVA	Prime
3000 kVA	Stdby
3100 kVA	w/o fan

43°C & 50°C cooling options

Accepts 100% block load

G3 class transient performance

On-board paralleling with EMCP 4.4

4 point lift with installed radiator

Full High/Low Voltage Range

Up to 5000A package mounted breakers

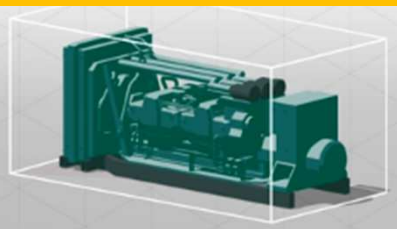
Connecting For Success…

- SAVES UP TO 28% INSTALLED SPACE
- WEIGHS 30% LESS THAN COMPETITION
- 12% BETTER MOTOR STARTING
- FULL POWER UP TO 50^{O} C
- 4 POINT LIFT WITH RADIATOR

LIGHTER WEIGHT | EASIER HANDLING | SMALLER FOOTPRINT

LOWER INSTALLED COST

FOOTPRINT – 16.70M^2



FOOTPRINT – 19.63M^2

FOOTPRINT – 24.07M^2

Connecting For Success…

Cat 3516E – Competitive Comparison

		Rating (kVA)	Footprint (m2)	Mass (kg)	Std. Cooling (°C)	Load Response 30% Voltage Dip (skVA)
Cat	3516E	3000	16.7	21045	43	5215
Cummins	QSK78-G9	2900	19.6	22824	40	4640
MTU	20V4000G63	3100	24.1	28357	40	3600

Cat C32

1375 kVA	Prime
1500 kVA	Stdby

G3 class transient performance

Accepts 100% block load

50°C cooling standard

On-board paralleling with EMCP 4.4

Up to 5000A package mounted breakers

Optional Form Wound Gen

Connecting For Success…

- SAVES UP TO 27% INSTALLED SPACE
- WEIGHS 31% LESS THAN COMPETITION
- 46% BETTER MOTOR STARTING
- FULL POWER UP TO 50^{O} C
- AVAILABLE DUAL PACKAGE MOUNTED BREAKERS

LIGHTER WEIGHT | EASIER HANDLING | SMALLER FOOTPRINT

LOWER INSTALLED COST

Connecting For Success…

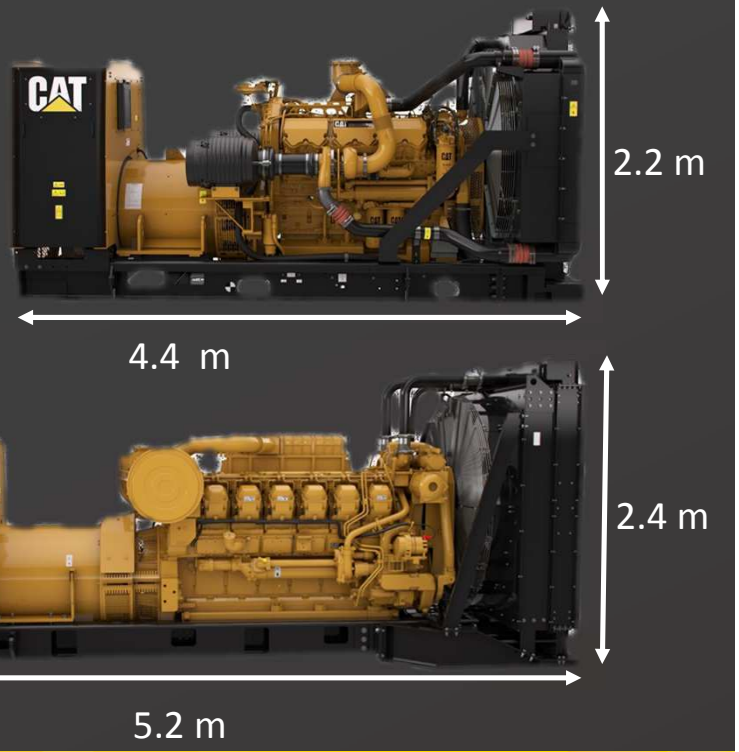
Cat C32 – Competitive Comparison

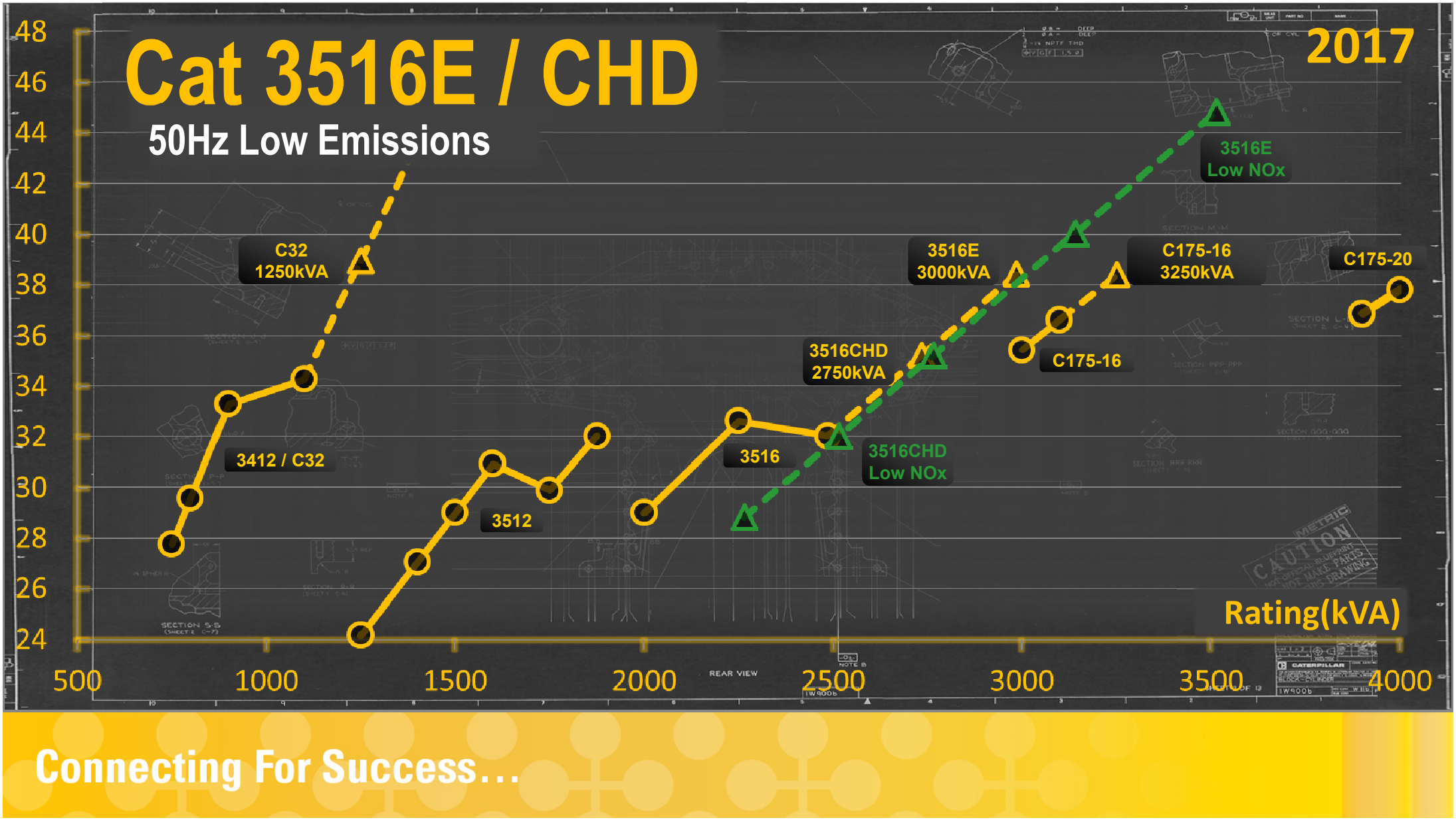
		Rating (kVA)	Footprint (m2)	Mass (kg)	Std. Cooling (°C)	Load Response 30% Voltage Dip (skVA)
Cat	C32	1500	9.0	7600	50	3658
Cummins	KTA50-G3	1400	11.6	10324	40	2500
MTU	18V2000G76	1400	10.0	8200	40	3040

Cat C32 – Installed Cost Case Study

Value of Power Density

	Cat 3512 10.4m²	Cat C32 9.0m²	Savings	%
Transportation	$39k	$32k	$7k	18%
Enclosure, etc.	$300k	$270k	$30k	10%
Site / Installation	Not yet installed			



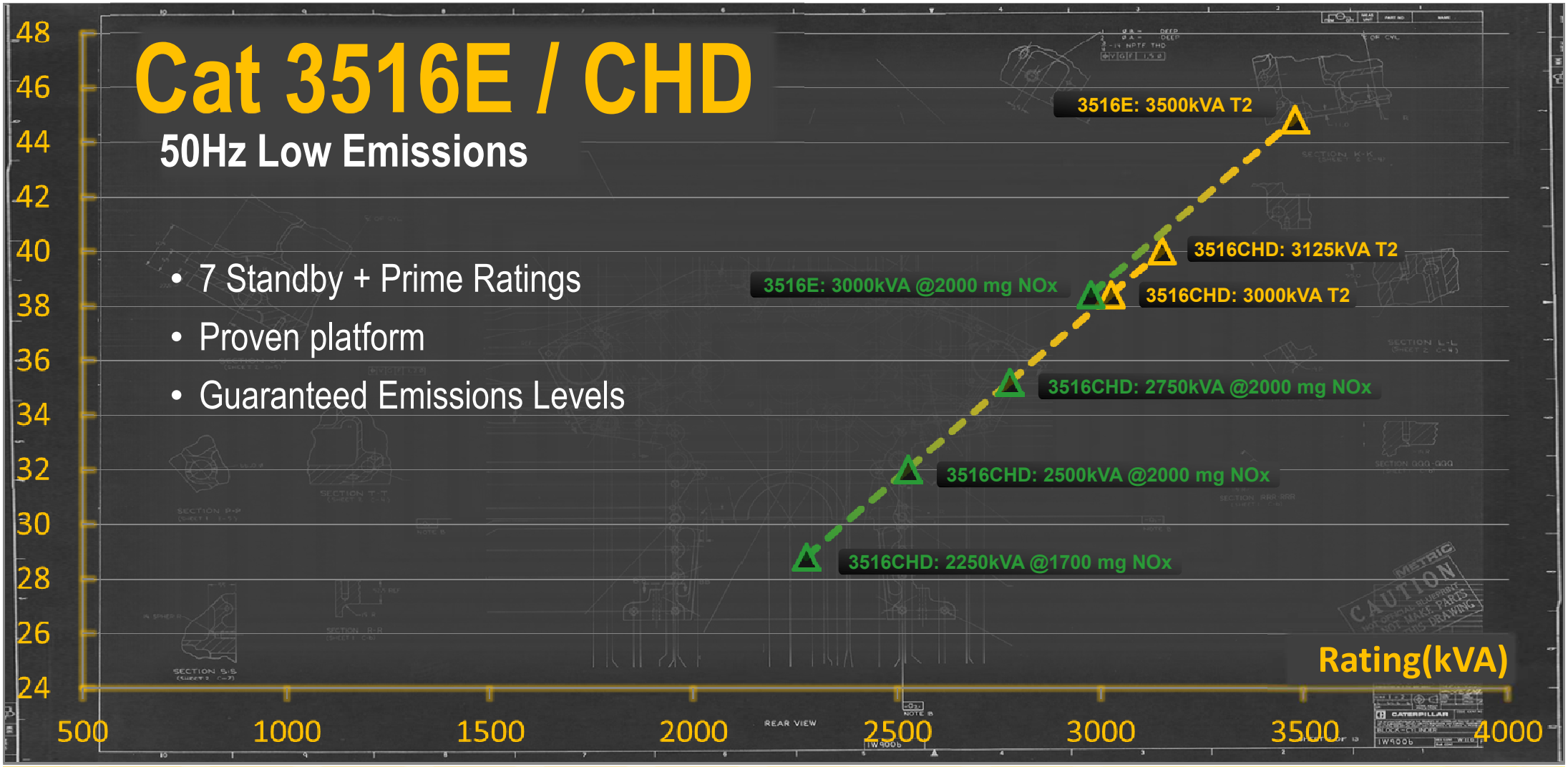


Connecting For Success…

Cat 3516E / CHD

50Hz Low Emissions

- 7 Standby + Prime Ratings
- Proven platform
- Guaranteed Emissions Levels

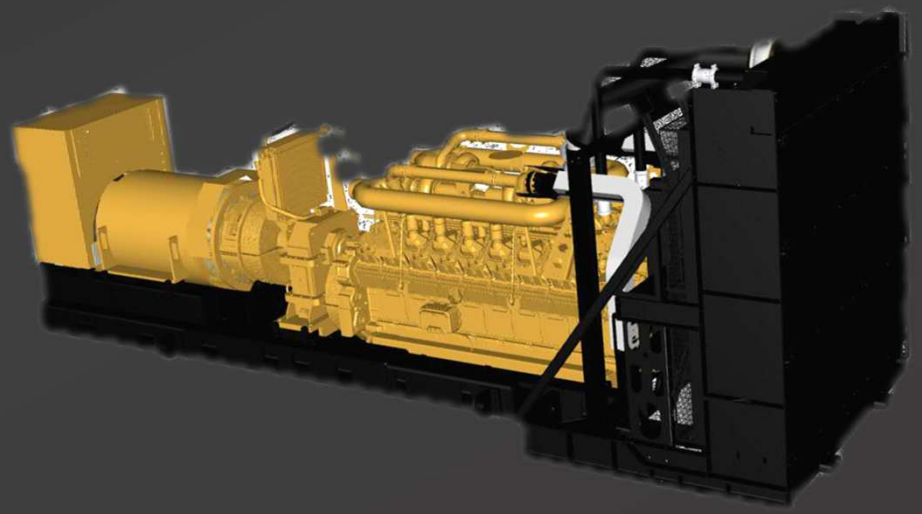


Connecting For Success…

Cat 3516E / CHD

50Hz Low Emissions

	Standby Rating (kVA)	Regulation	Targeted Performance
3516CHD	2250	<½ TA Luft	1700mg
	2500	½ TA Luft	<2000mg
	2750	½ TA Luft	<2000mg
	3000	US EPA Tier 2	Tier 2
	3125	US EPA Tier 2	Tier 2
3516E	3000	½ TA Luft	<2000mg
	3500	US EPA Tier 2	Tier 2

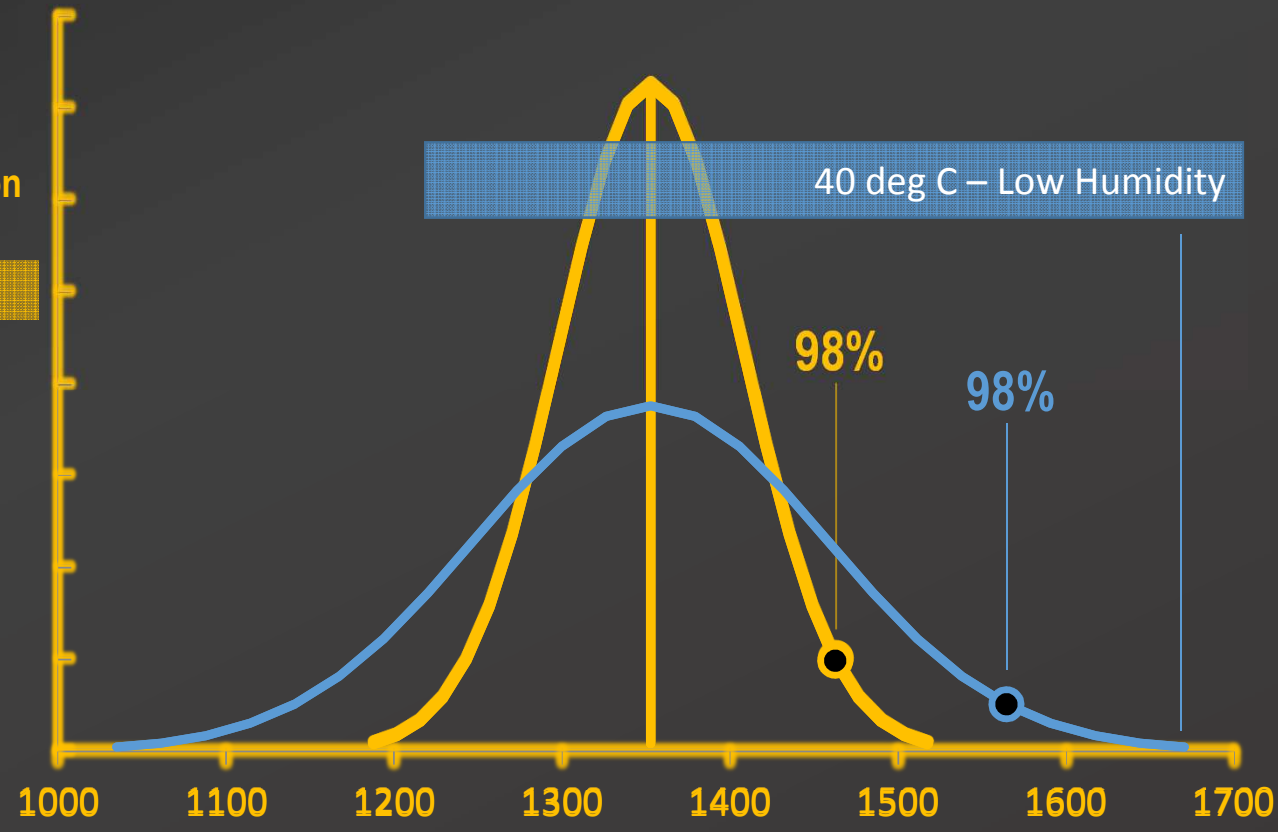


Connecting For Success…

Cat 3516E / CHD

50Hz Low Emissions

	Standby Rating (kVA)	Regulation	Project Specification
3516CHD	2250	<½ TA Luft	1700mg
	2500	½ TA Luft	<2000mg
	2750	½ TA Luft	<2000mg
	3000	US EPA Tier 2	Tier 2
	3125	US EPA Tier 2	Tier 2
3516E	3000	½ TA Luft	<2000mg
	3500	US EPA Tier 2	Tier 2



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Cat 3516E / CHD

50Hz Low Emissions

	Standby Rating (kVA)	Regulation	Project Specification	Nominal Std Conditions	Engine to Engine Variation	Max Variation ~40C + low humidity
3516CHD	2250	<½ TA Luft	1700mg	1353	1520	1670
	2500	½ TA Luft	<2000mg	1566	1750	1910
	2750	½ TA Luft	<2000mg	1665	1862	2000
	3000	US EPA Tier 2	Tier 2	2318	2592	2687
	3125	US EPA Tier 2	Tier 2	2349	2626	2734
3516E	3000	½ TA Luft	<2000mg	1665	1862	2000
	3500	US EPA Tier 2	Tier 2	2638	2950	3543

Cat 3516E / CHD

50Hz Low Emissions

	Standby Rating (kVA)	Project Specification	Nominal Std Conditions	Engine to Engine Variation	Max Variation ~40C + low humidity
Cat 3516CHD	2250	1700mg	1353	1520	1670
Cummins QSK60-G11	2250	1700mg	2640	-	-
MTU 16V4000G23	2200	1700mg	-	1700	-

Connecting For Success…

Cat 3516E / CHD

50Hz Low Emissions

	Standby Rating (kVA)	Regulation	Project Specification	Nominal Std Conditions	Engine to Engine Variation	Max Variation ~40C + low humidity
3516CHD	2250	<½ TA Luft	1700mg	1353	1520	1670
	2500	½ TA Luft	<2000mg	1566	1750	1910
	2750	½ TA Luft	<2000mg	1665	1862	2000
	3000	US EPA Tier 2	Tier 2	2318	2592	2687
	3125	US EPA Tier 2	Tier 2	2349	2626	2734
3516E	3000	½ TA Luft	<2000mg	1665	1862	2000
	3500	US EPA Tier 2	Tier 2	2638	2950	3543

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Cat 3516E / CHD

50Hz Low Emissions

	Standby Rating (kVA)	Project Specification	Nominal Std Conditions	Engine to Engine Variation	Max Variation ~40C + low humidity
Cat 3516CHD	2750	<2000mg	1665	1862	2000
Cummins QSK78-G15/16	2750	<2000mg	1935	-	-
MTU 20V4000G23	2650	<2000mg	-	1700	-

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ELECTRIC POWER RATINGS GUIDE

GENERATOR SETS

kVA				Generator Set Model	Configuration
Standby	Mission Critical	Prime	Continuous		
1500 rpm					
750	—	680	—	3412C	Low BSFC
800	—	725	—	3412C	Low BSFC
900	—	810	—	3412C	Low BSFC
1100	1100	1000	910	C32	Low BSFC, Low Emissions
1250	1250	1100	—	C32	Low BSFC
1250	1250	1150	1000	3512	Low BSFC
1400	1400	1275	—	C32	Low BSFC
1400	1400	1275	1206	3512	Low BSFC
1500	1500	1375	—	C32	Low BSFC
1500	1500	1360	—	3512B	Low BSFC, Low Emissions
1600	1600	1500	1320	3512B	Low BSFC, Low Emissions
1750	1750	1600	—	3512B	Low BSFC, Low Emissions
1875	1875	1700	1500	3512B	Low BSFC, Low Emissions
2000	2000	1825	1600	3516	Low BSFC
2250	2250	2000	—	3516C	Low Emissions
2250	2250	2000	1750	3516B	Low BSFC, Low Emissions
2500	2500	2275	—	3516C	Low Emissions
2500	2500	2275	2000	3516B	Low BSFC, Low Emissions
2750	2750	2500	—	3516C	Low BSFC , Low Emissions
3000	3000	2750	—	3516C	EPA Tier 2
3000	3000	2725	—	3516E	Low Emissions
3000	3000	2750	—	3516E	Low BSFC
3000	3000	2750	2500	C175-16	Low BSFC, Low Emissions
3125	3125	2800	—	3516C	EPA Tier 2
3500	3000	3125	—	3516E	EPA Tier 2
3900	3900	3500	3150	C175-20	Low BSFC, Low Emissions
4000*	4000*	3600*	3250*	C175-20	Low BSFC, Low Emissions

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