

Chillventa Specialist Forums 2022

Chillventa Fachforen 2022

**CONNECTING
EXPERTS.**



MARSTAIR

REFRIGERATION AND SPECIALIST AIR CONDITIONING

MARSTAIR

Hall 6
Stand 117

A2L SOLUTIONS

Presented By

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In partnership with

QUARTZ
FAN COILS AND HVAC

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A summary of the challenges A2L refrigerants face for split system cold room applications relative to refrigerant charge limits, flammability limits, room sizes and pipe runs.

How does the Marstair A2LsysteMatch overcome this with case study examples.

Product Ranges:

- ✓ F-Gas Regulation and EN 378 Standard
- ✓ A2LsystemMatch Development
- ✓ A2LsystemMatch Case Studies
- ✓ Total Cost of Ownership (TCO) & Environmental Benefits
- ✓ A2L Selection Software

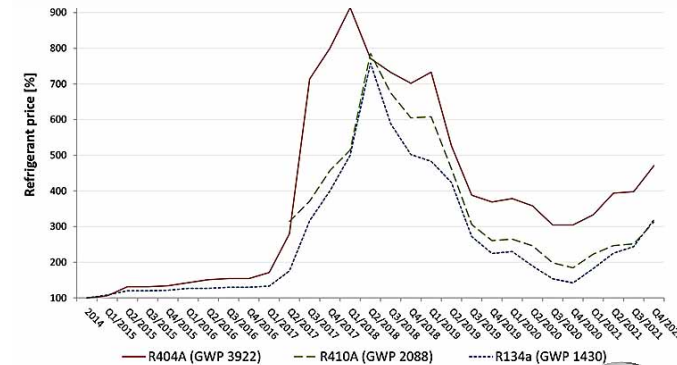
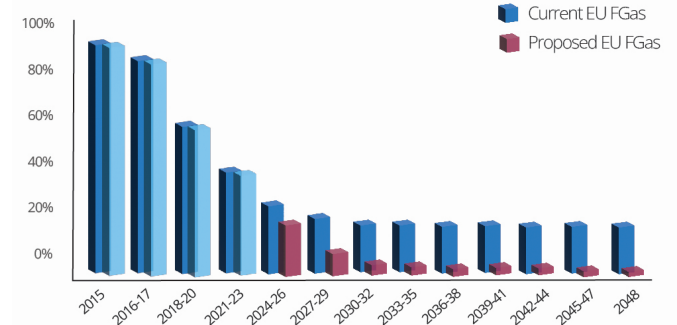
Regulation Details:-

- Most common current refrigerants have a GWP of 1400.
- Average GWP in the market has dropped to GWP 900 in 2021
- Refrigerant price increased 10 fold due to previous phase down in 2018
- Refrigerant price already rising this year due to this phase down.
- Brexit increasing pressure on UK refrigerant quota, increasing prices further
- Products sold to suit old refrigerants will have a limited product life due to availability of refrigerant

Average GWP EU & UK per kg refrigerant													
Year	2015	16-17	18-20	21-23	24-26	27-29	30-32	33-35	36-38	39-41	42-44	45-47	49
GWP	2000	1860	1260	900	472	200	103	96	77	69	62	55	48
%	100%	93.0%	63.0%	45.0%	23.6%	10.0%	5.2%	4.8%	3.9%	3.5%	3.1%	2.8%	2.4%

Refrigeration						
Refrigerant	GWP	Flammable	Average charge weight kg	System GWP	Percentage 2015	Equivalent phase out year
R404A	3922	No	3	11766	100.0%	2016
R449A	1397	No	3	4191	35.6%	2024
R454C	148	Yes	1	148	1.3%	Beyond 2048

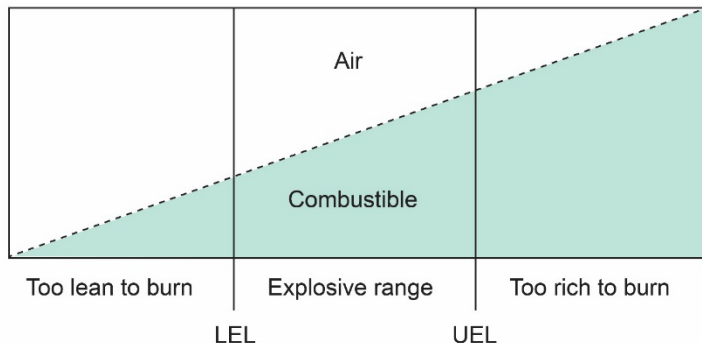
F-Gas Phase Down



Standard Details:

- New A2L refrigerants have a GWP of 150 but are flammable
- Standard limits A2L refrigerant charge to 20% X room volume X LFL (Lower Flammability limit)
- R454C has a LFL of 0.293kg/m³
- Example: 20m³ Room allows 20% X 0.293 X 20 = 1.17kg refrigerant.

LEL vs. UEL



Flammability class	Access category		Location classification			
			I - Occupied Space	II - Comp. In mach.-room / open air	III - All ref component in mach.-room / open air	Ventilated enclosure
2L	a General Access	Human comfort	According to C.2 and not more than $m_2 \text{ ax } 1,5$ or According to C.3 and not more than $m_3 \text{ b } \times 1,5$		No charge restrictions	Refrigerant charge not more than $m \text{ ax } 1,5$
		Other applications	20 % x LFL x Room volume and not more than $m_2 \text{ ax } 1,5$ or According to C.3 and not more than $m_3 \text{ b } \times 1,5$			
	b Superv. Access	Human comfort	According to C.2 and not more than $m_2 \text{ ax } 1,5$ or According to C.3 and not more than $m_3 \text{ b } \times 1,5$			
		Other applications	20 % x LFL x Room volume and not more than $m_3 \text{ a } \times 1,5$ or according to C.3 and not more than $ff3 \text{ b } \times 1,5$	20 % x LFL x Room volume and not more than 25 $k \text{ f}$ or according to C.3 and not more than $m \text{ s } \text{ b } \times 1,5$		
	c Author. Access	Human comfort	According to C.2 and not more than $m_2 \text{ a } \times 1,5$ or According to C.3 and not more than $m_3 \text{ b } \times 1,5$			
		Other applications	20 % x LFL x Room volume and not more than $m_3 \text{ a } \times 1,5$ or according to C.3 and not more than $m_3 \text{ h } \times 1,5$	20 % x LFL x Room volume and not more than 25 $k \text{ g}$ or according to C.3 and not more than $m_3 \text{ b } \times 1,5$		
		<1 person per 10 m^2	20 % x LFL x Room volume and not more than 50 $k \text{ g a o r}$	No charge restrictions		

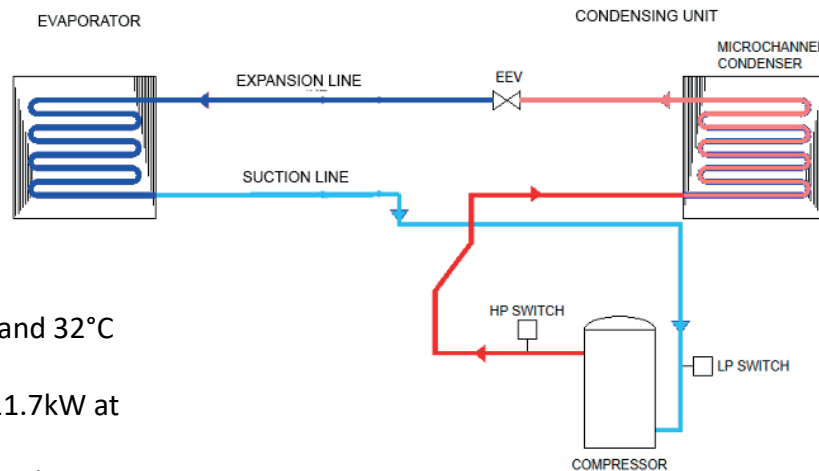
Project Details:

- F-gas regulations require the use of **lower GWP refrigerants**
- A2L systems **offer 98% GWP reduction**
- A2L refrigerants are flammable resulting in new development challenges
- CellarMatch is an **Award winning approach**
- Improved Energy efficiency over R449A and CO2 systems
- Total Cost of Ownership **25% less than CO2**
- Simple skill uplift compared to CO2
- Suitable for 3 A2L refrigerants, R454A, R454C and R455A

Product Performance:

- Cellar systems available between 2.4 & 7.4kW @ 12.7°C internal and 32°C external ambient.
- Chilled Cold room and cabinet systems available between 1.0 & 11.7kW at 0°C room, -10°C evaporating and 32°C external ambient.
- Freezer Cold room and cabinet systems available between 1.0 & 5.6kW at -23°C room, -30°C evaporating and 32°C external ambient.

Critically charged system schematic with expansion lines

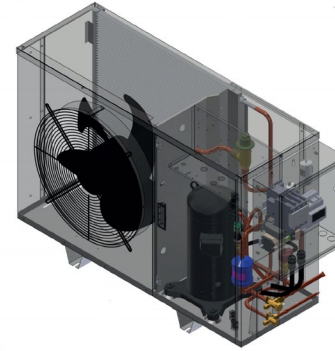


Example Cold Room Matches:

Medium Temperature - R454C (-8°C Evaporating temperature / 0°C return Air / 32°C External)											
Cooling kW	Condensing unit	Box Evaporator	System charge Om	5m Pipe Run		10m Pipe Run		15m Pipe Run		20m Pipe Run	
				System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³
1.3	SMC+15	MBMTE125A	0.28	0.36	6.1	0.440	7.5	0.520	8.9	0.6	10.2
1.6	SMC+20	MBTME125B	0.295	0.375	6.4	0.455	7.8	0.535	9.1	0.615	10.5
1.9	SMC+30	MBMTE130B	0.350	0.430	7.3	0.510	8.7	0.590	10.1	0.67	11.4
2.4	SMC+40	MBMT130E	0.460	0.540	9.2	0.620	10.6	0.700	11.9	1.060	18.1
3.2	SMC+45	MBMT230B	0.654	0.734	12.5	0.814	13.9	1.104	18.8	1.254	21.4
4.6	SMC+50	MBMT230C	0.738	0.818	14.0	1.038	17.7	1.188	20.3	1.338	22.8
5.7	SMC+80	MBMT230E	0.955	1.035	17.7	1.255	21.4	1.405	24.0	1.555	26.5
6.5	SMC+90	MBMT230BE	1.280	1.430	24.4	1.580	27.0	1.730	29.5	1.880	32.1

Project Details:

- Current SMC units can be **matched with cabinets**
- Requires **A2L compliant cabinets**
- Cabinet Coils details are required to calculate refrigerant charge sizes
- New SMC+ units **being developed for multi-split applications**

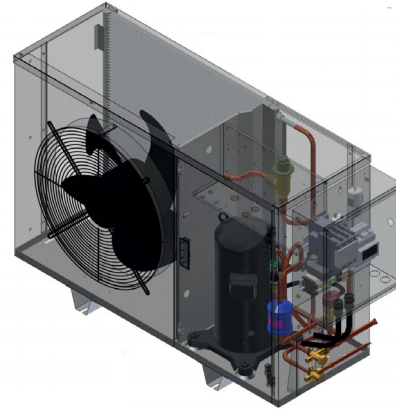


Example Cabinet Matches:

Medium Temperature - R454C (-8°C Evaporating temperature / 32°C External)																						
CU Cooling kW	Condensing unit	Required Cabinet Cooing	Cabinet Size	Doors	System charge Om	5m Pipe Run				10m Pipe Run				15m Pipe Run				20m Pipe Run				
						System charge	BS EN 378 Minimum Room Size m³	Expansion line size	Suction line size	System charge	BS EN 378 Minimum Room Size m³	Expansion line size	Suction line size	System charge	BS EN 378 Minimum Room Size m³	Expansion line size	Suction line size	System charge	BS EN 378 Minimum Room Size m³	Expansion line size	Suction line size	
1.6	SMC+20	1.6	1.25	No	0.499	0.579	9.9	3/8"	3/8"	0.659	11.3	3/8"	1/2"	0.739	12.6	3/8"	1/2"	0.819	14.0	3/8"	1/2"	
2.4	SMC+40	2.4	1.875	No	0.660	0.740	12.6	3/8"	1/2"	0.820	14.0	1/2"	1/2"	0.900	15.4	1/2"	5/8"	1.260	21.5	1/2"	5/8"	
3.2	SMC+45	3.2	2.5	No	1.032	1.112	19.0	3/8"	1/2"	1.192	20.3	1/2"	1/2"	1.482	25.3	1/2"	5/8"	1.632	27.9	1/2"	5/8"	
5.7	SMC+80	4.8	3.75	No	1.424	1.504	25.7	1/2"	5/8"	1.724	29.4	1/2"	5/8"	1.874	32.0	1/2"	3/4"	2.024	34.5	1/2"	3/4"	
1.3	SMC+15	0.88	1.25	Yes	0.512	0.592	10.1	3/8"	3/8"	0.672	11.5	3/8"	1/2"	0.752	12.8	3/8"	1/2"	0.832	14.2	3/8"	1/2"	
1.6	SMC+20	1.32	1.875	Yes	0.677	0.757	12.9	3/8"	3/8"	0.837	14.3	3/8"	1/2"	0.917	15.7	3/8"	1/2"	0.997	17.0	3/8"	1/2"	
1.9	SMC+30	1.76	2.5	Yes	0.882	0.962	16.4	3/8"	1/2"	1.042	17.8	3/8"	1/2"	1.122	19.1	3/8"	1/2"	1.202	20.5	3/8"	5/8"	
3.2	SMC+45	2.64	3.75	Yes	1.389	1.469	25.1	3/8"	1/2"	1.549	26.4	1/2"	1/2"	1.839	31.4	1/2"	5/8"	1.989	33.9	1/2"	5/8"	

Product Details:

- Updated A2L compliant evaporators
- All the advantages of Marstair CXE systems, except A2L
- Lightweight
- Duel purpose Ceiling and wall mounting brackets included
- Anti-bacterial chassis
- Electrics box with door



Example Cellar Cooler Matches:

R454C (12.7°C return Air / 32°C External)											
Cooling kW	Condensing unit	CXE A2L	System charge 0m	5m Pipe Run		10m Pipe Run		15m Pipe Run		20m Pipe Run	
				System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³
2.4	SMC+20	30	0.295	0.375	6.4	0.455	7.8	0.535	9.1	0.615	10.5
2.7	SMC+30	30	0.320	0.400	6.8	0.480	8.2	0.560	9.6	0.640	10.9
4.4	SMC+45	50	0.655	0.735	12.5	0.815	13.9	1.105	18.9	1.255	21.4
6.2	SMC+50	70	0.760	0.840	14.3	1.060	18.1	1.210	20.7	1.360	23.2
7.4	SMC+80	70	0.970	1.050	17.9	1.270	21.7	1.420	24.2	1.570	26.8

4 Cold Room Systems

- Main Chill
- Main Frozen
- ISB Bakery Chiller
- Produce Chiller

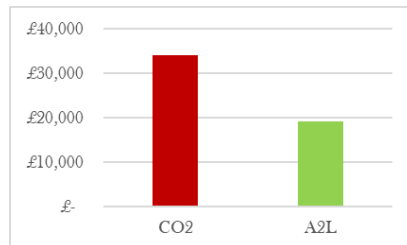
Total
Refrigerant
4 systems
= 3.2kg



The **co-operative**
Central England Co-operative

Capital Cost Comparison

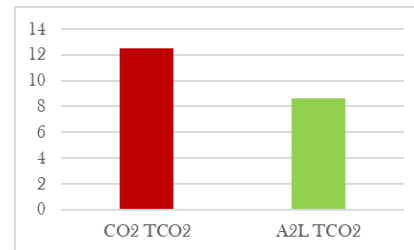
- CO2 total cost - £34,000
- A2L total cost - £19,158



Annual Emissions

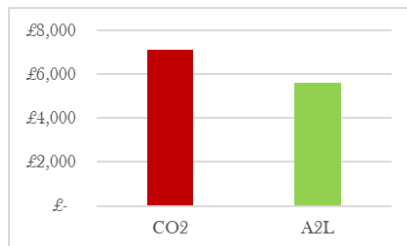
- CO2 cold rooms – 12.54 TCO2
- A2L cold rooms – 8.60 TCO2

*Based on a 3% leak rate and an emissions factor of 0.21233



Annual Energy Consumption

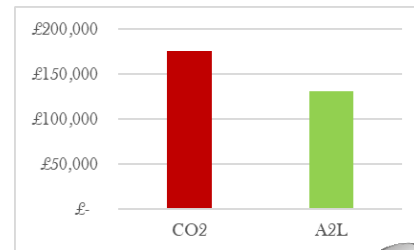
- CO2 cold room consumption cost £7,096
- A2L cold room consumption cost £5,602



Total Cost of Ownership

- CO2 - £175,920
- A2L - £131,198

*Based on 20-year energy performance + CAPEX



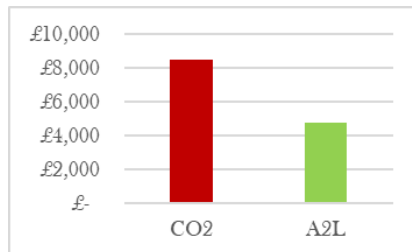


1 Cold Room System

Total Refrigerant = 0.38kg!!!

Capital Cost Comparison

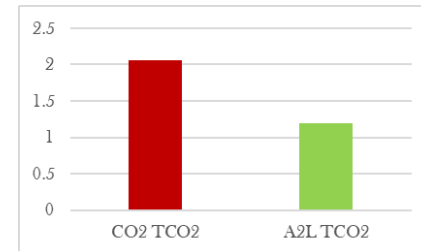
- CO2 cost - £8,500
- A2L cost - £4,789



Annual Emissions

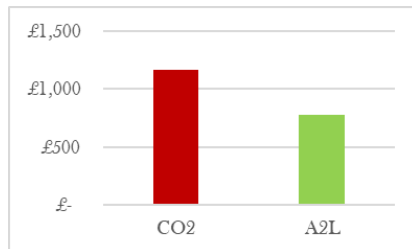
- CO2 coldrooms – 2.06 TCO2
- A2L coldrooms – 1.2 TCO2

*Based on a 3% leak rate and an emissions factor of 0.21233



Annual Energy Consumption

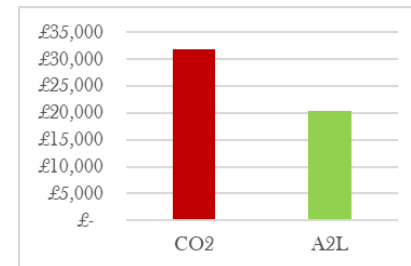
- CO2 coldroom consumption cost £1,166
- A2L coldroom consumption cost £780



Total Cost of Ownership

- CO2 - £31,820
- A2L - £20,389

*Based on 20-year energy performance + CAPEX



As we began our low carbon refrigeration journey, we realised that an important piece of the jigsaw was missing. Marstair stepped up to the challenge and in 2021 provided nine individual SysteMatch A2L systems that operate all of the cold rooms at our flagship store in Bootle. These systems meet the key requirements of our refrigeration strategy whilst providing great value for money when compared to other low carbon refrigeration options.

– Brian Churchyard – Asda



The Co-op are delighted that their store at Kibworth has been future-proofed with low-GWP refrigeration systems that save energy, capital cost whilst also reducing system emissions. When compared to CO2, the four A2LsysteMatch systems will save an incredible >25% across a 20-year Total Cost of Ownership!

– Central England Co-op

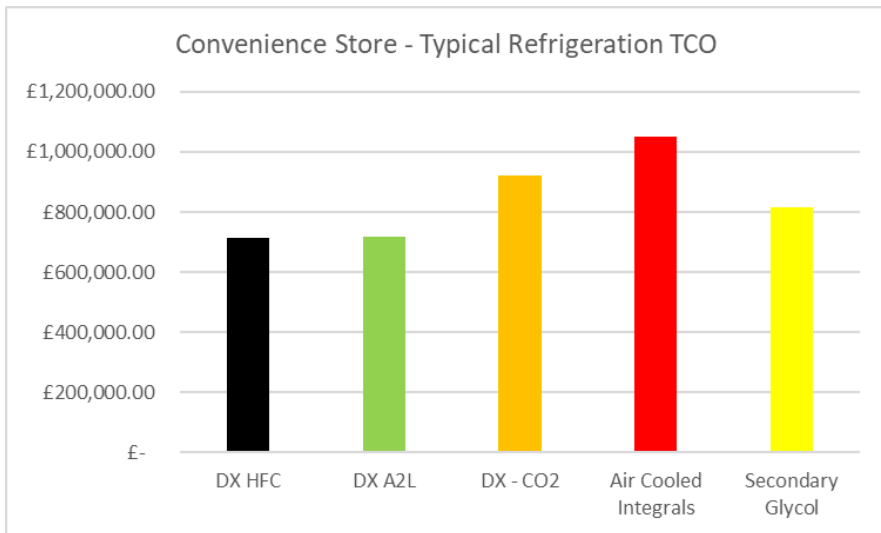
The **co-operative**
Central England Co-operative

The uplift in cost for this state-of-the-art unit was minimal and one we were very happy to pay given the environmental benefit and to future proof our business. Since it's installation Core Refrigeration have been to site to make sure it's running well and check things over and have always been happy.

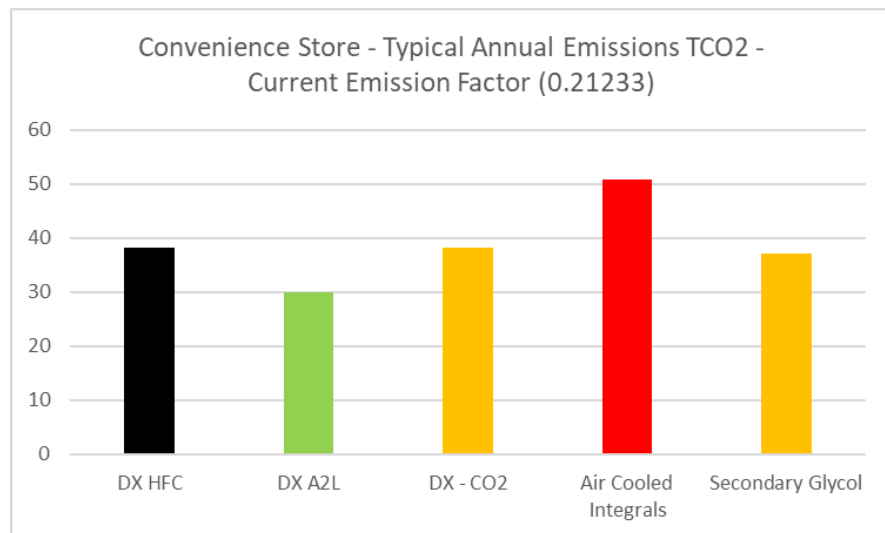
– Hay Deli



TOTAL COST OF OWNERSHIP (CURRENT ENERGY RATE)



ANNUAL EMISSIONS (CURRENT EMISSIONS FACTOR – 0.21233)



A2L SYSTEMMATCH

SELECTION TOOL

RESULTS

Input

Duty Requirement (kW)

2

Internal Room Temperature (°C)

0

External Ambient Temperature (°C)

32

Evaporating Temperature (°C)

-7

Pipe Run (m)

20

Room Volume (m³)

25

Refrigerant Type

R454C

Selection

Duty at Design Conditions (kW)

2.188

Evaporator

MBMT130E

Condensing Unit

SMC 30

Suction Pipe Size

5/8"

Expansion Pipe Size

3/8"

Refrigerant Charge (kg)

0.840

Minimum Room Size (m³)

14.334

Dsear Free Volume (m³)

4.977

Free Volume Proportion (%)

19.908

Alternative

Duty at Design Conditions (kW)

1.890

Evaporator

MWMT130B

Condensing Unit

SMC 20

Suction Pipe Size

1/2"

Expansion Pipe Size

3/8"

Refrigerant Charge (kg)

0.640

Minimum Room Size (m³)

10.922

Dsear Free Volume (m³)

4.294

Free Volume Proportion (%)

17.177

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The selection tool is **FREE** is
use and can be accessed at
<https://a2l.marstair.com/>



Example of an A2LsystemMatch at installation **ASDA**



Thank You | Q&A:

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