Australian food cold chain council

Optimising the Cold Chain

Presented by
Mark Mitchell | Chairman AFCCC

Webinar 18th May 2021

Introduction

This presentation will provide an overview of the food cold chain, and an introduction to some of the guiding principles and requirements necessary for its improvement.

The content and conclusions are presented from the results of the work I am currently doing as a cold chain practitioner with my company SuperCool and from the policies and objectives currently under focus by the Australian Food Cold Chain Council (AFCCC) of which I am the current Chairman.

We are also in collaboration with all our affiliated partners in the task of optimising the cold chain.

Headline figures: Food Waste from Australia's cold chain

- Total value (farm gate prices) of food waste at least AUD $3.8 billion annually which comprised of:
  - 25% (1,930,000 tonnes) of annual fruit and vegetable production worth $3.0 billion
  - 3.5% of annual production of meat (155,000 tonnes) and seafood (8,500 tonnes) worth $670 million and $90 million respectively; and,
  - 1% (90,000 tonnes) of dairy products valued at $70 million.
- Estimates of losses in the food cold chain do not include impacts of poor temperature control which reduces product shelf life.

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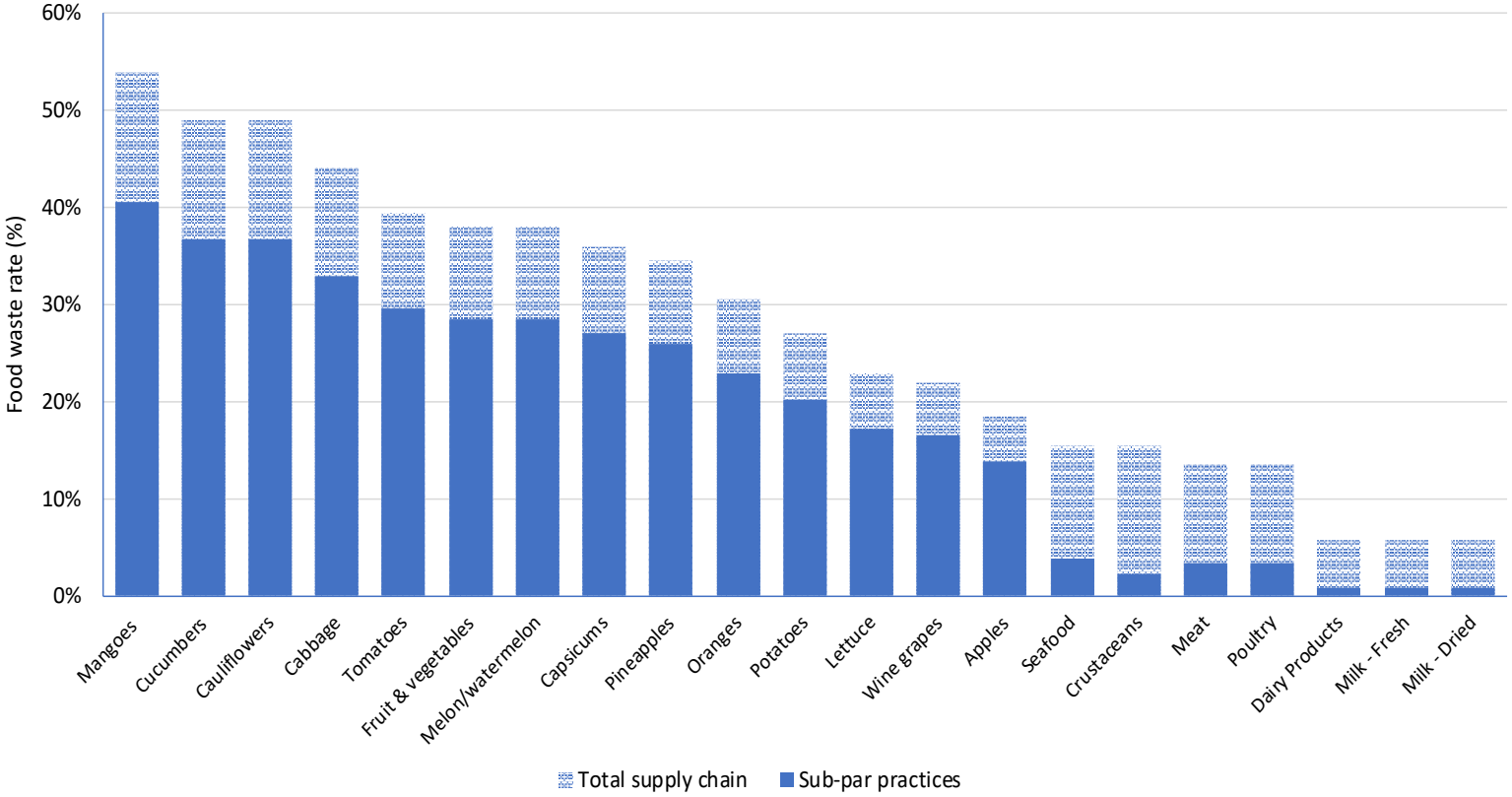
Rate of fresh produce loss by type



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Why do we have food loss and waste in the cold chain?

In 2020, the Environment Department and Refrigerants Australia funded analysis into this question. It found three areas:

1. Better food handling, such as reducing the time food spends outside refrigerated environments during transfer and more accurate measurement of food temperatures

2. Increased use of tracking/tracing technologies; and

3. Improved 'chain of custody' documentation ensuring shared responsibilities for maintaining food quality

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Introduction

Compliance to **worlds best practices** is now on the Australian agenda due to the global food loss and wastage (FLW) crisis and its triple bottom line.

Commercial, consumer, logistics and contractual arrangements should no longer ignore food safety and the opportunity for FLW reduction.

New technology and systems are always at the forefront of the refrigeration industry and the cold chain, however proper implementation of existing first level technology is required to achieve compliant and optimised cold chains in Australia

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The heavy stuff first

The cold chain is a temperature-controlled supply chain of separate refrigerated events sufficient to achieve continuous temperature control of perishable goods. An unbroken, or compliant cold chain is an uninterrupted series of these events used to store and transport perishable products from one destination to another.

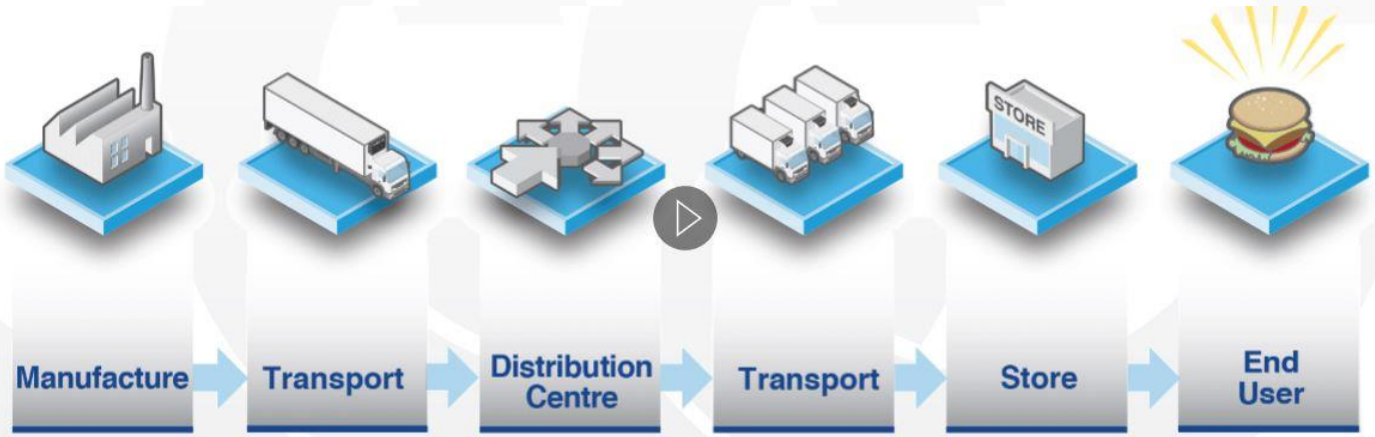
It is also a **Quality Management System (QMS)** where verification and validation at each step in that process or system is required. There are several QMS platforms to use such as;

CAPA - Corrective action and preventive action (ISPE APQ Guide
FMEA - Failure mode effects analysis
BRC-British Retail Consortium
SQF- Safe quality food
And others

But **HACCP (Hazard Analysis Critical Control Points)** is considered the most appropriate QMS for food cold chain applications

The heavy stuff first

The modern cold chain when based on the principles of **HACCP** identifies food processing and delivery procedures at their individual steps to ensure food quality and integrity, including temperature, is maintained from the beginning to the end.



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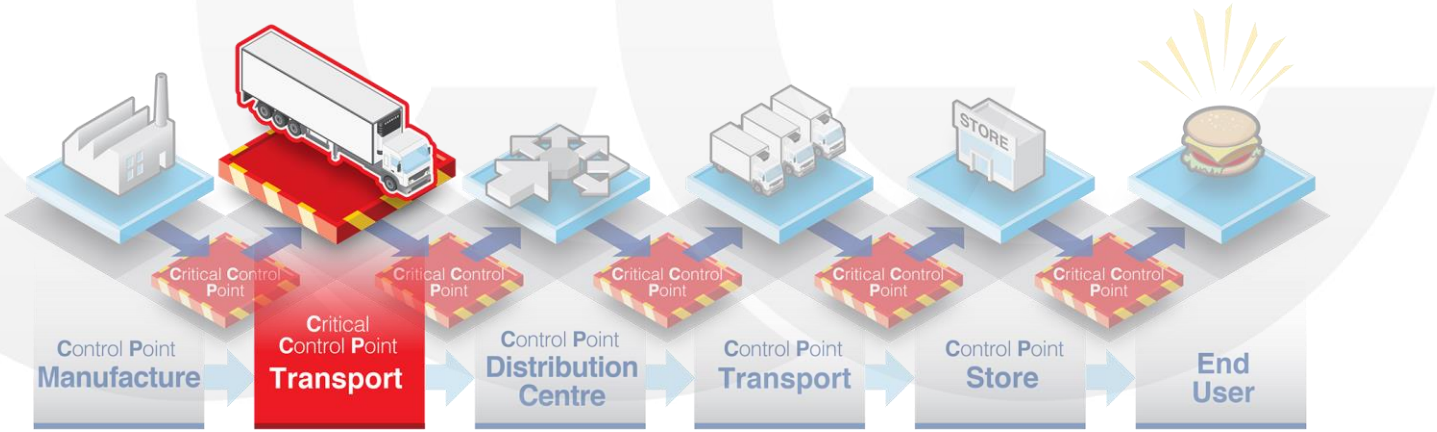
The heavy stuff first

The steps in a **HACCP process** are separated into control points and critical control points

A cold chain **control point (CP)** is where the food temperature and the environment is controlled, such as inside a warehouse or in a monitored refrigerated transport.

A cold chain **critical control point (CCP)** is where there is no temperature control, which typically are those areas of the chain where the goods are handled from one control point to the next or transported in an asset with inadequate controls.



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The heavy stuff first

A **HACCP process** is a quality management system.

The critical component of a quality management system is to ensure verification and validation takes place at all steps in the system.

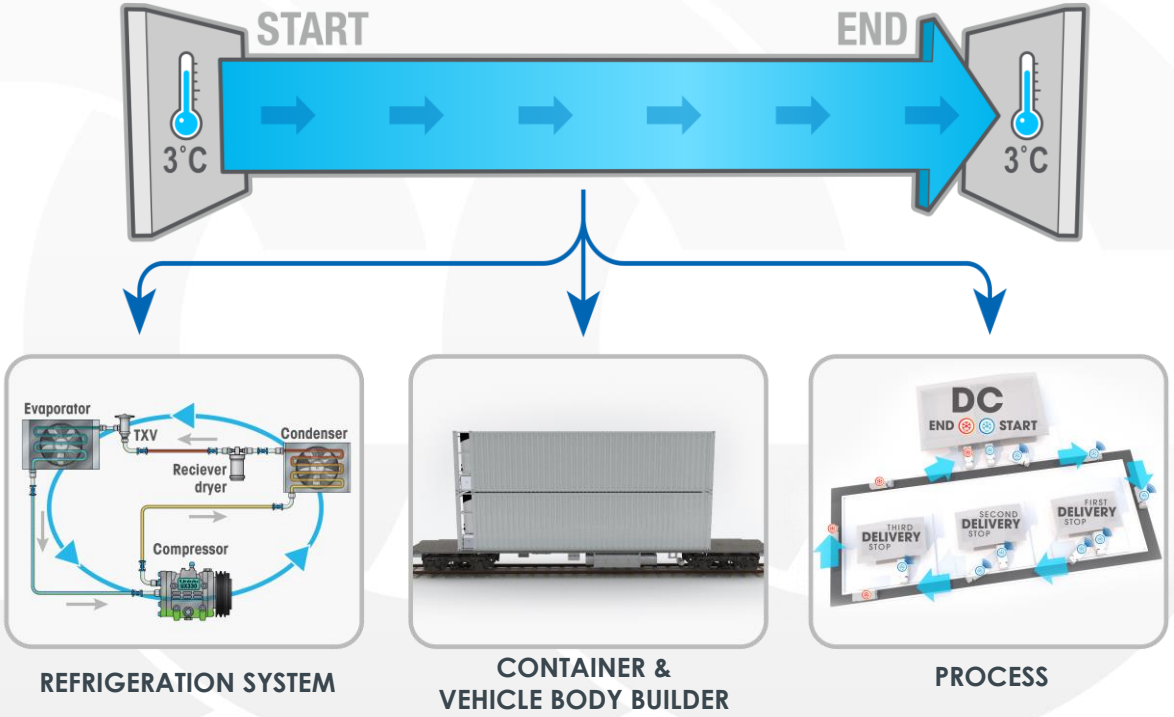
Verification is test or measurement of a system to prove that it meets all its specified requirements at a particular stage or step.

Validation is an activity that ensures a product meets the needs of the end-user upon completion of the process.

In cold chain language, this means temperature verification must occur at all **CP and CCP steps** during the cold chain process.

Validation takes place at the end point when the end-user is satisfied the product is a quality condition and can be eaten. This is made possible by standard end-point temperature checks and a review of temperature records from the relative the cold chain process to ensure temperature abuse did not occur.

The process - simplified



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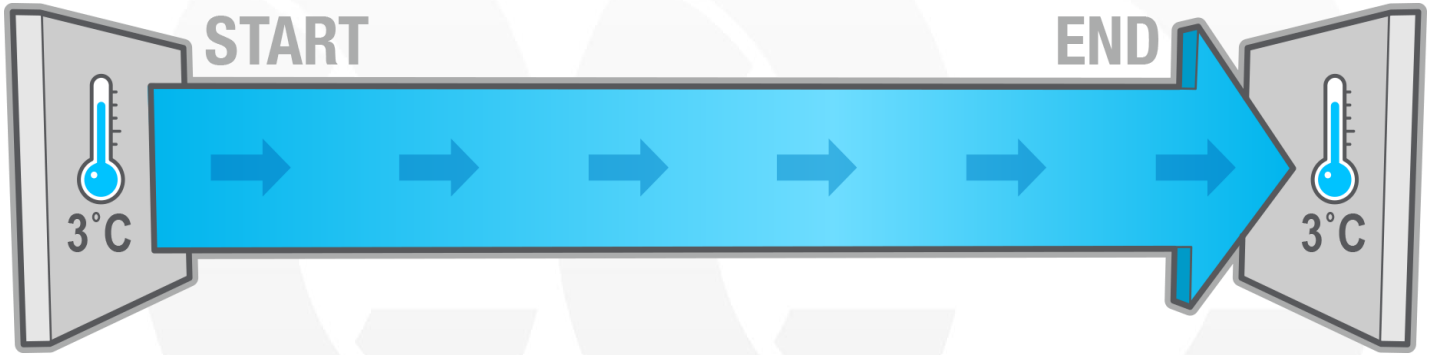
The process - simplified



When food is stored and transported
at its correct temperature,
losses are reduced and shelf life is honored

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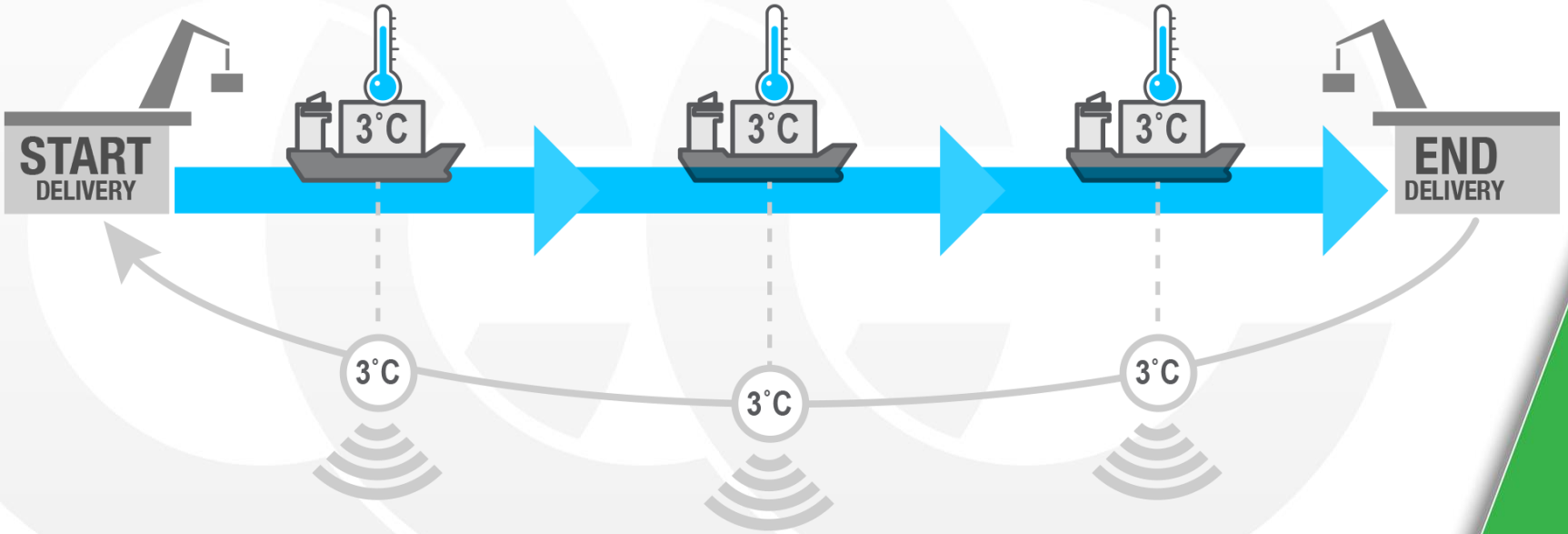
Cold chain type – end to end



Multiple ownership of temperature makes verification harder, temperature abuse more common, and avoidance of responsibility easier

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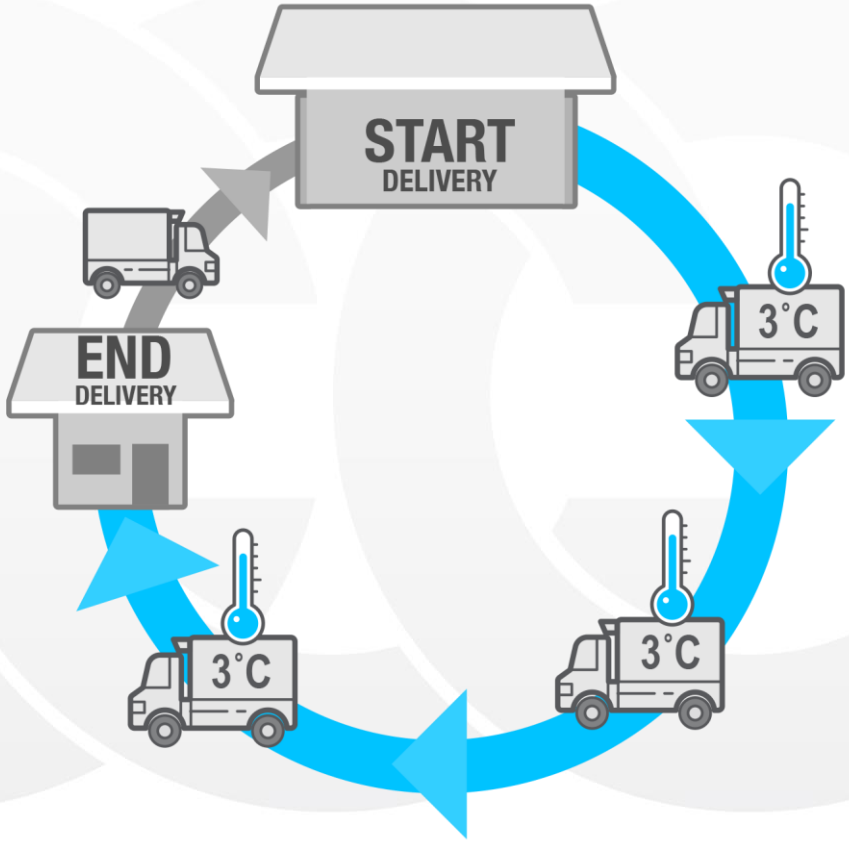
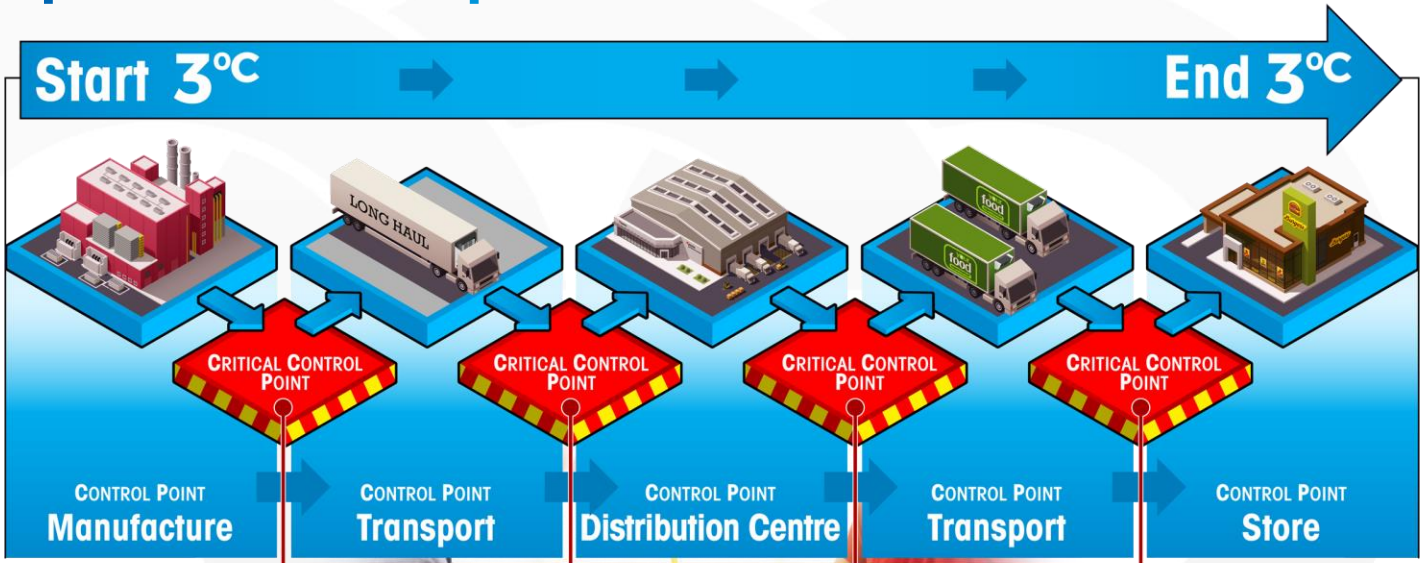
Cold chain type – closed loop



Single ownership of temperature, clear responsibility

The process - simplified



Cold chain transport and storage is a chain of events separated into Control Points (CP) and Critical Control Points (CCP)

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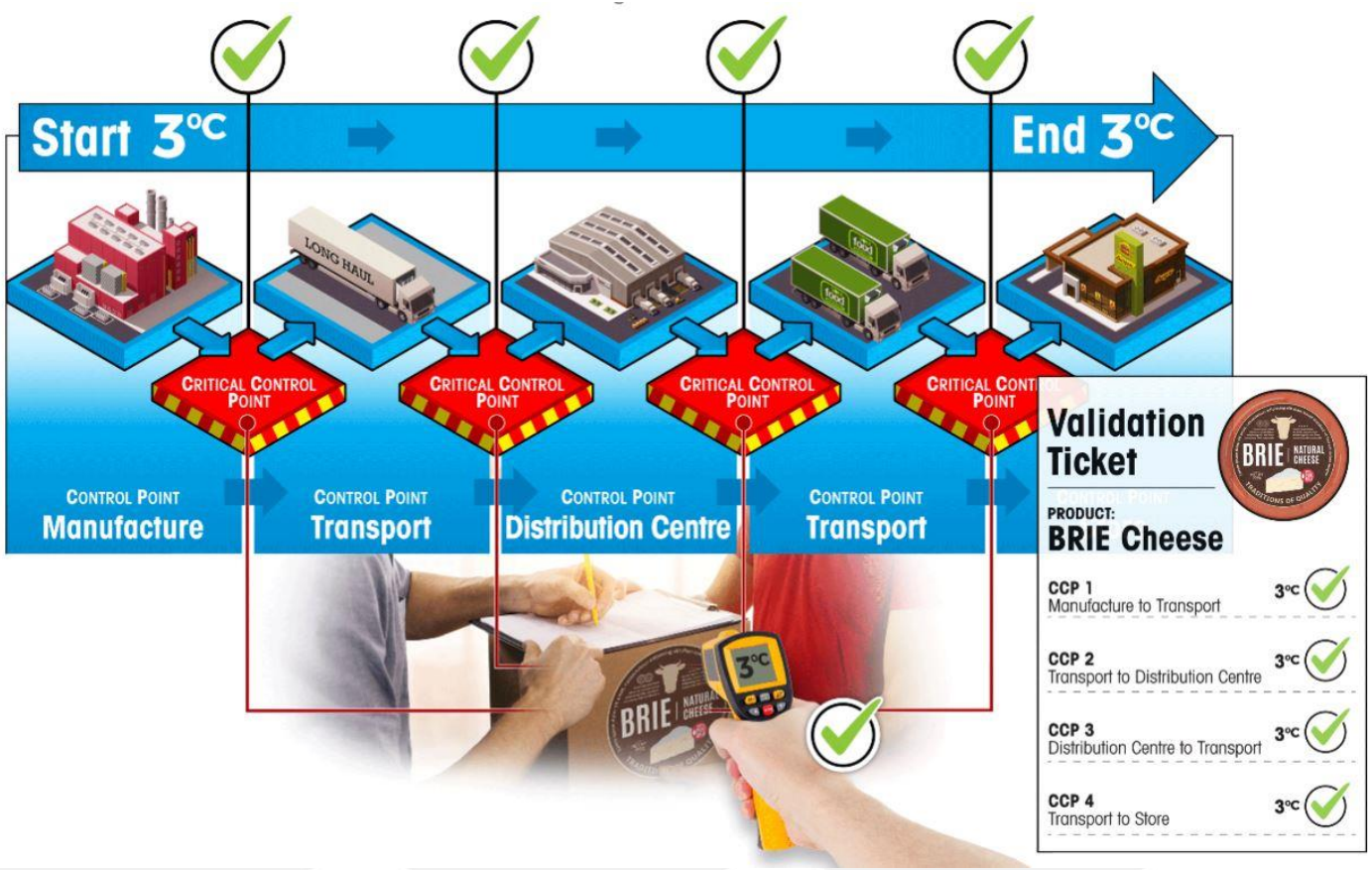

A compliant cold chain verifies its product temperature between all stakeholders

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The big message

If you are a cold chain practitioner and want to be part of an optimised cold chain

Become an optimiser

To become an optimiser, you need to be a verifier

You are verifier if the cold chain process allows you measure temperature at all points and hand them over during receiving and delivery

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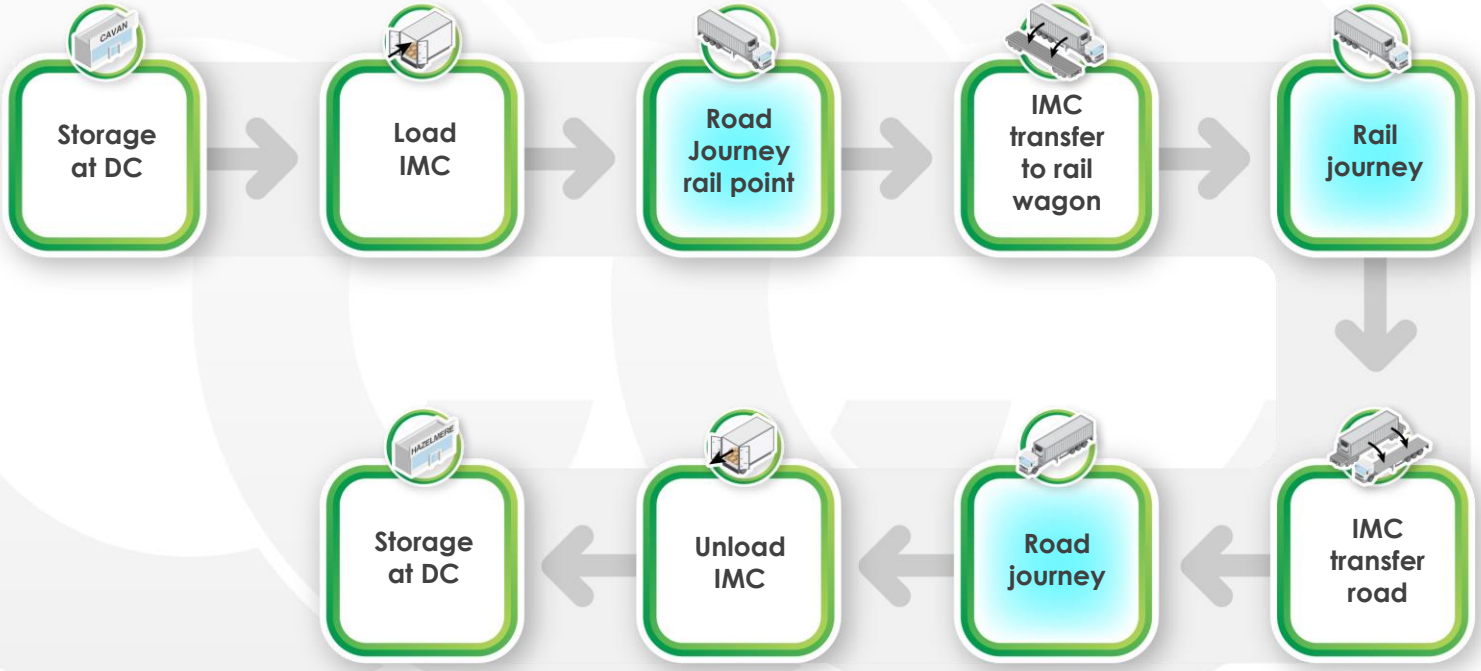
Long haul example - road and rail cold chain



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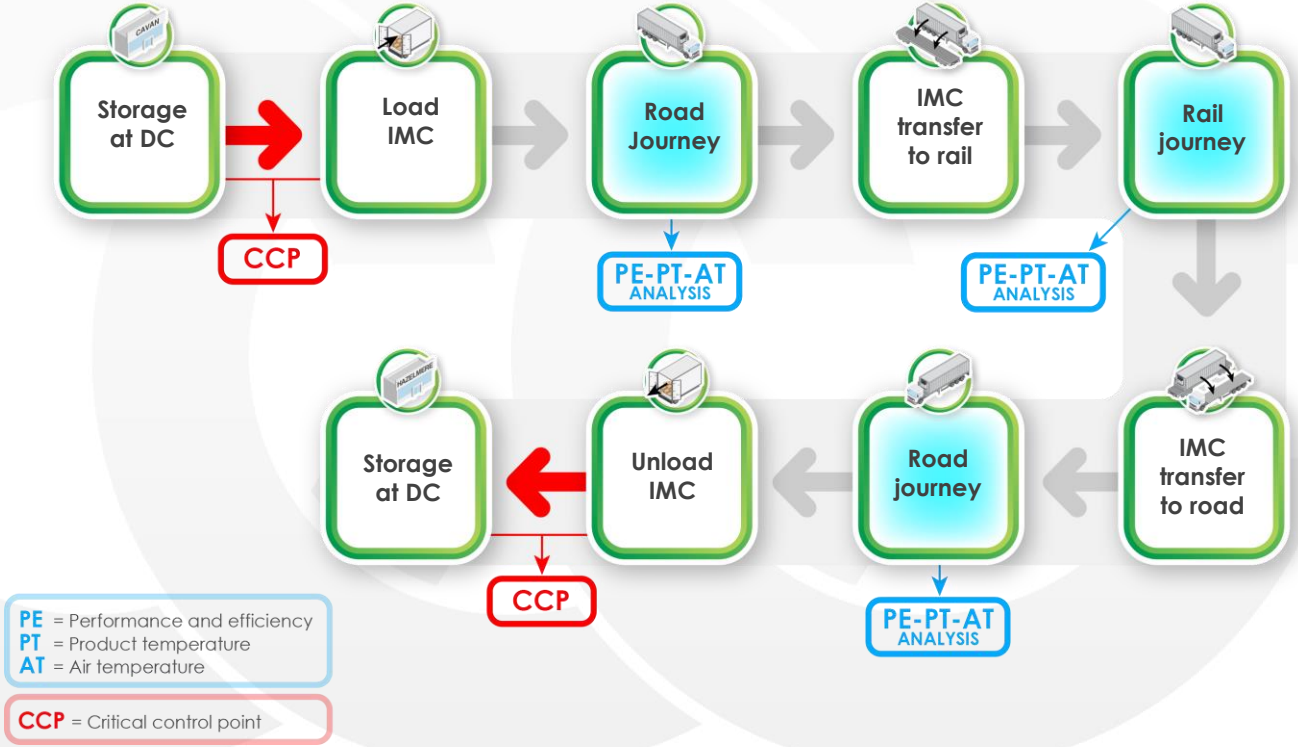
Monitoring and data points for verification



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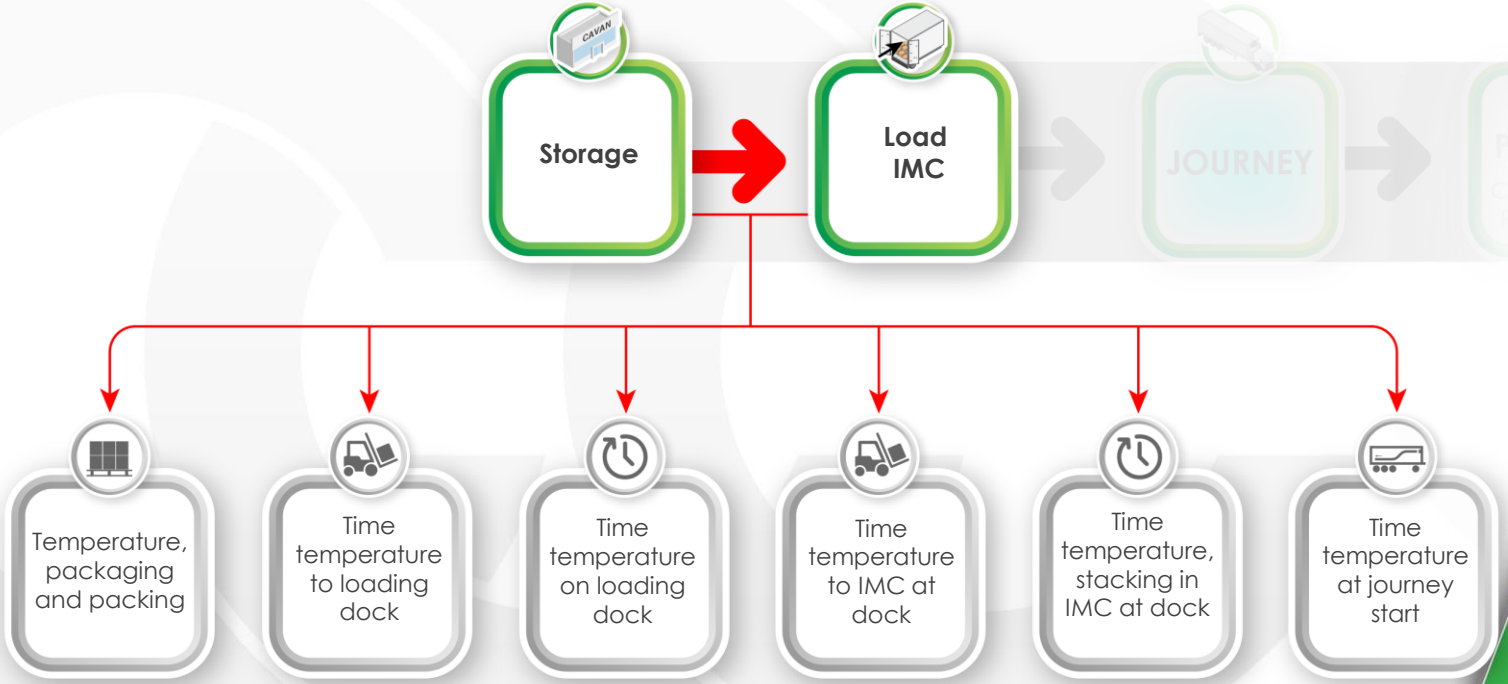
The critical control points are CRITICAL



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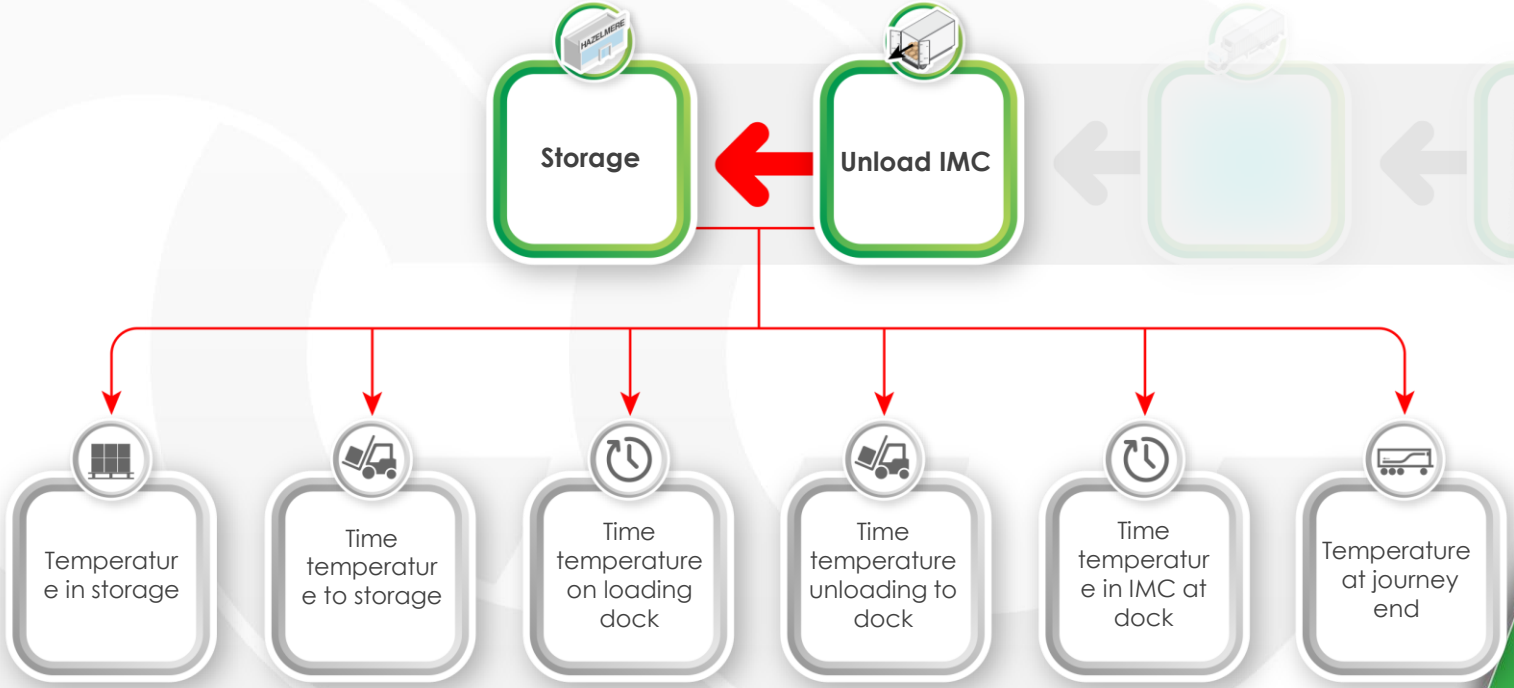

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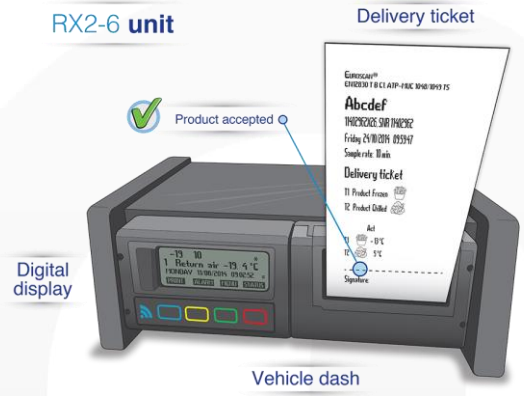
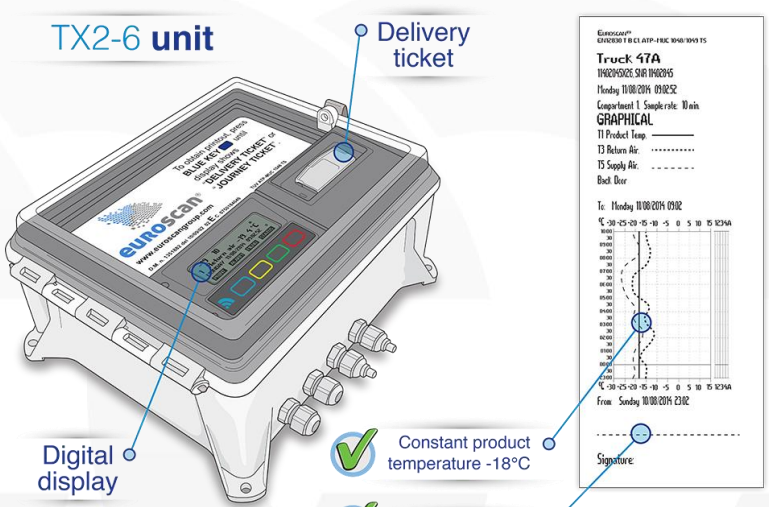
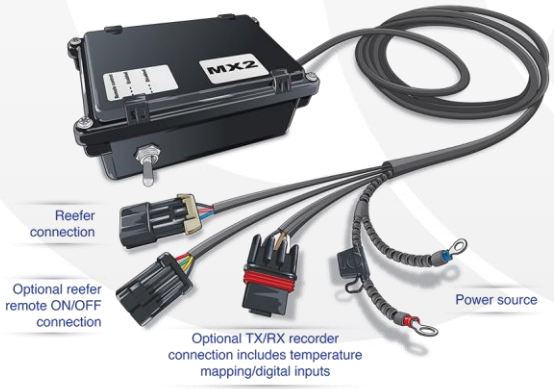
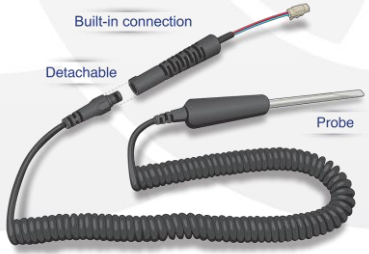
Stacks of hardware alternatives available









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Product temperature monitoring must be continuous…..
end point only not good enough.
Automatic systems are best

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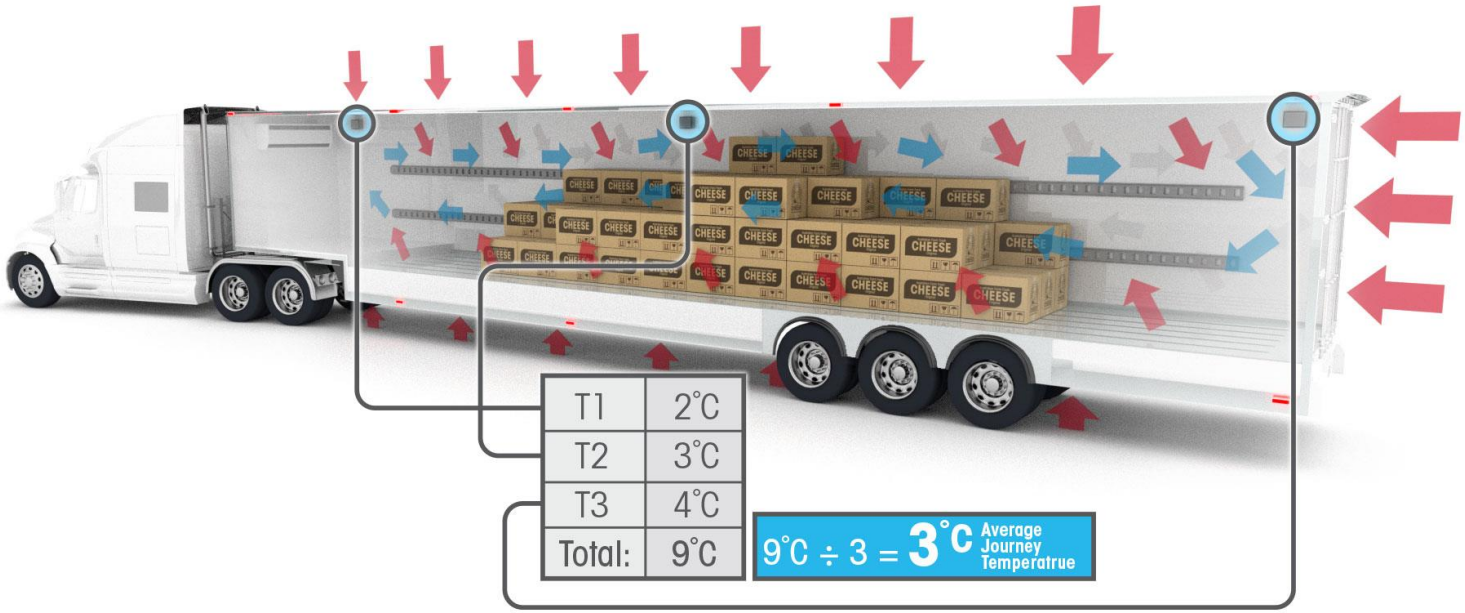

Journey temperature mapping is second best to probing.
Must be continuous and automatic.

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Smart product probe technology is here

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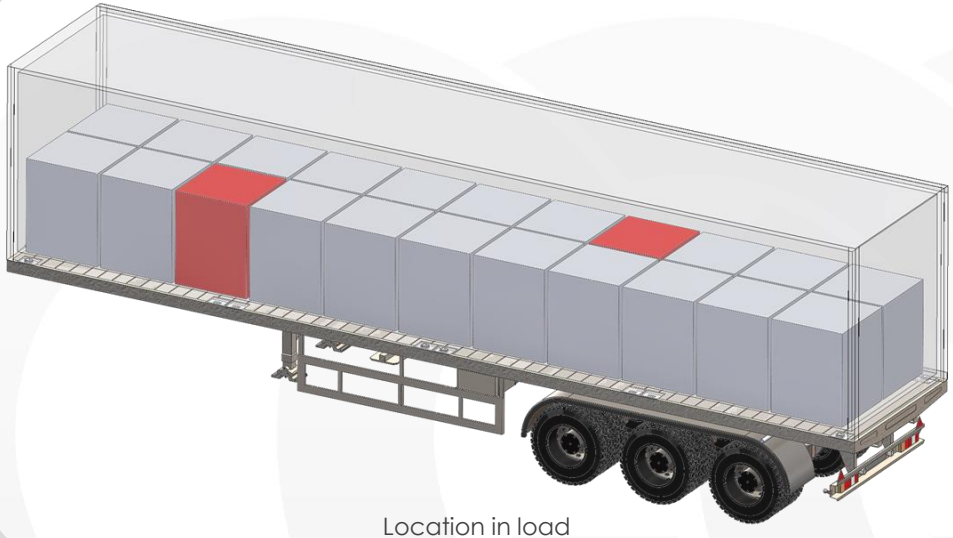
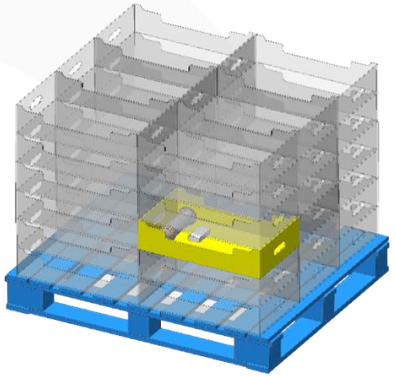


Location in load



Location on pallet

Location of temperature acquisition must be meaningful

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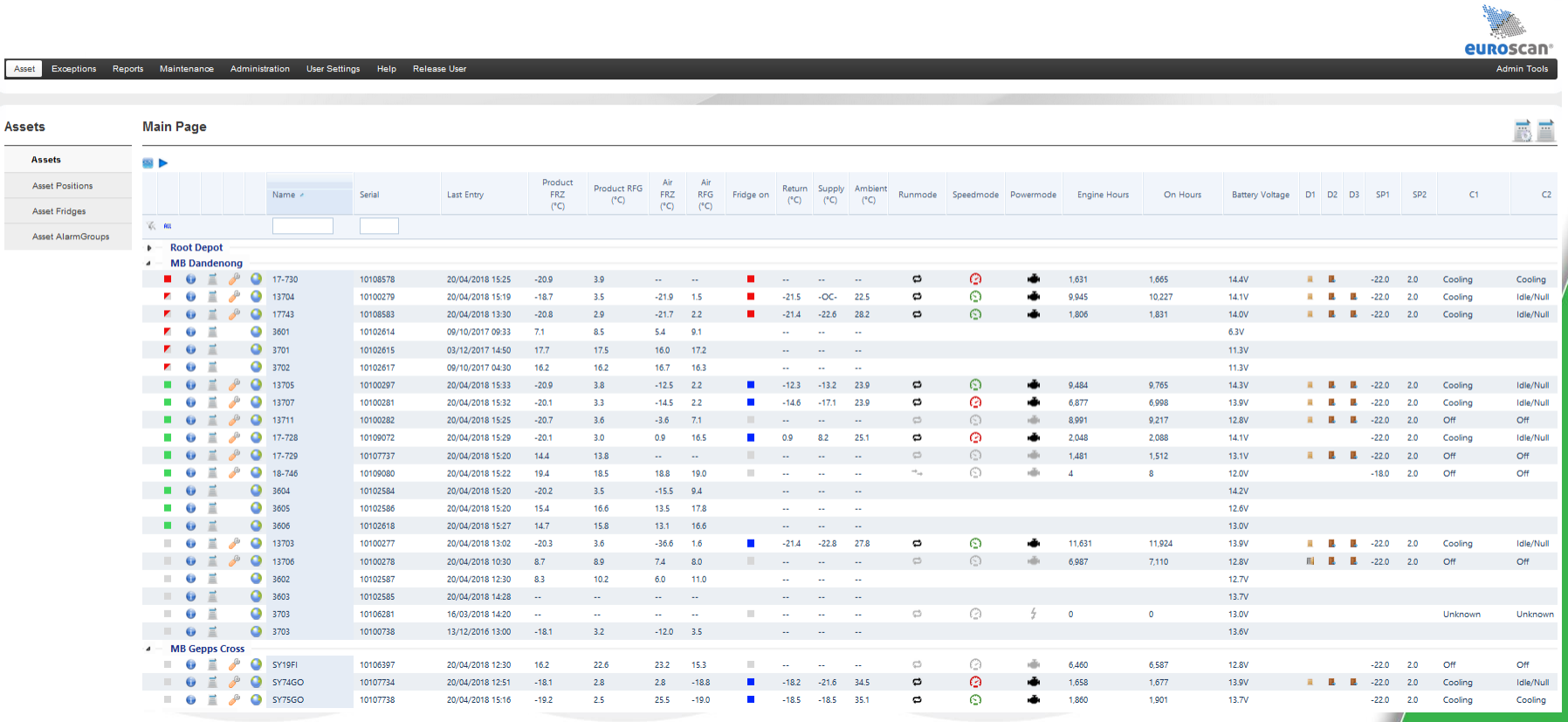
Data from web portals and telematics must acted upon



Name	Serial	Last Entry	Product FRZ (°C)	Product RFG (°C)	Air FRZ (°C)	Air RFG (°C)	Fridge on	Return (°C)	Supply (°C)	Ambient (°C)	Runmode	Speedmode	Powermode	Engine Hours	On Hours	Battery Voltage	D1	D2	D3	SP1	SP2	C1	C2
Root Depot																							
MB Dandenong																							
17-730	10108578	20/04/2018 15:25	-20.9	3.9	--	--		--	--	--				1,631	1,665	14.4V				-22.0	2.0	Cooling	Cooling
13704	10100279	20/04/2018 15:19	-18.7	3.5	-21.9	1.5		-21.5	-OC-	22.5				9,945	10,227	14.1V				-22.0	2.0	Cooling	Idle/Null
17743	10108583	20/04/2018 13:30	-20.8	2.9	-21.7	2.2		-21.4	-22.6	28.2				1,806	1,831	14.0V				-22.0	2.0	Cooling	Idle/Null
3601	10102614	09/10/2017 09:33	7.1	8.5	5.4	9.1		--	--	--						6.3V							
3701	10102615	03/12/2017 14:50	17.7	17.5	16.0	17.2		--	--	--						11.3V							
3702	10102617	09/10/2017 04:30	16.2	16.2	16.7	16.3		--	--	--						11.3V							
13705	10100297	20/04/2018 15:33	-20.9	3.8	-12.5	2.2		-12.3	-13.2	23.9				9,484	9,765	14.3V				-22.0	2.0	Cooling	Idle/Null
13707	10100281	20/04/2018 15:32	-20.1	3.3	-14.5	2.2		-14.6	-17.1	23.9				6,877	6,998	13.9V				-22.0	2.0	Cooling	Idle/Null
13711	10100282	20/04/2018 15:25	-20.7	3.6	-3.6	7.1		--	--	--				8,991	9,217	12.8V				-22.0	2.0	Off	Off
17-728	10109072	20/04/2018 15:29	-20.1	3.0	0.9	16.5		0.9	8.2	25.1				2,048	2,088	14.1V				-22.0	2.0	Cooling	Idle/Null
17-729	10107737	20/04/2018 15:20	14.4	13.8	--	--		--	--	--				1,481	1,512	13.1V				-22.0	2.0	Off	Off
18-746	10109080	20/04/2018 15:22	19.4	18.5	18.8	19.0		--	--	--				4	8	12.0V				-18.0	2.0	Off	Off
3604	10102584	20/04/2018 15:20	-20.2	3.5	-15.5	9.4		--	--	--						14.2V							
3605	10102586	20/04/2018 15:20	15.4	16.6	13.5	17.8		--	--	--						12.6V							
3606	10102618	20/04/2018 15:27	14.7	15.8	13.1	16.6		--	--	--						13.0V							
13703	10100277	20/04/2018 13:02	-20.3	3.6	-36.6	1.6		-21.4	-22.8	27.8				11,631	11,924	13.9V				-22.0	2.0	Cooling	Idle/Null
13706	10100278	20/04/2018 10:30	8.7	8.9	7.4	8.0		--	--	--				6,987	7,110	12.8V				-22.0	2.0	Off	Off
3602	10102587	20/04/2018 12:30	8.3	10.2	6.0	11.0		--	--	--						12.7V							
3603	10102585	20/04/2018 14:28	--	--	--	--		--	--	--						13.7V							
3703	10106281	16/03/2018 14:20	--	--	--	--		--	--	--				0	0	13.0V						Unknown	Unknown
3703	10100738	13/12/2016 13:00	-18.1	3.2	-12.0	3.5		--	--	--						13.6V							
MB Gepps Cross																							
SY19FI	10106397	20/04/2018 12:30	16.2	22.6	23.2	15.3		--	--	--				6,460	6,587	12.8V				-22.0	2.0	Off	Off
SY74GO	10107734	20/04/2018 12:51	-18.1	2.8	2.8	-18.8		-18.2	-21.6	34.5				1,658	1,677	13.9V				-22.0	2.0	Cooling	Idle/Null
SY75GO	10107738	20/04/2018 15:16	-19.2	2.5	25.5	-19.0		-18.5	-18.5	35.1				1,860	1,901	13.7V				-22.0	2.0	Cooling	Cooling

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Cold Chain View – data report

Asset

- Assets
- Asset Details
- **Data Report**
- Fridge Control
- PreTrips
- Position
- Assign AlarmGroups
- Edit AlarmGroups
- Configuration History

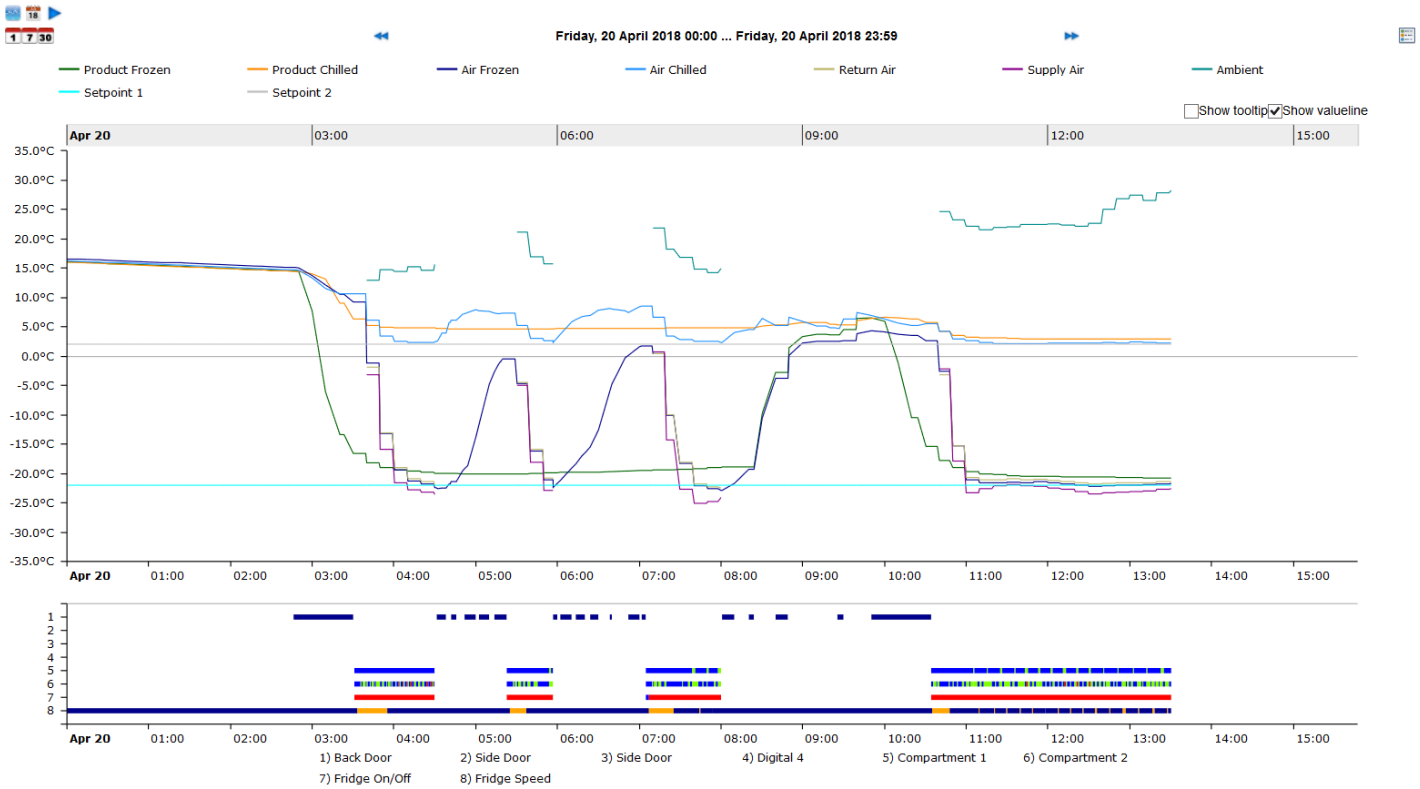
Asset Info

Name:	17743
Serial:	10108583
Type:	Euroscan MX2
Firmware:	1.35.0

Data Age

Accelerometer:	6 days
Battery:	2 hours
Fridge:	2 hours
Position:	2 hours
Sensors:	2 hours
Digitals:	5 hours

Data Report



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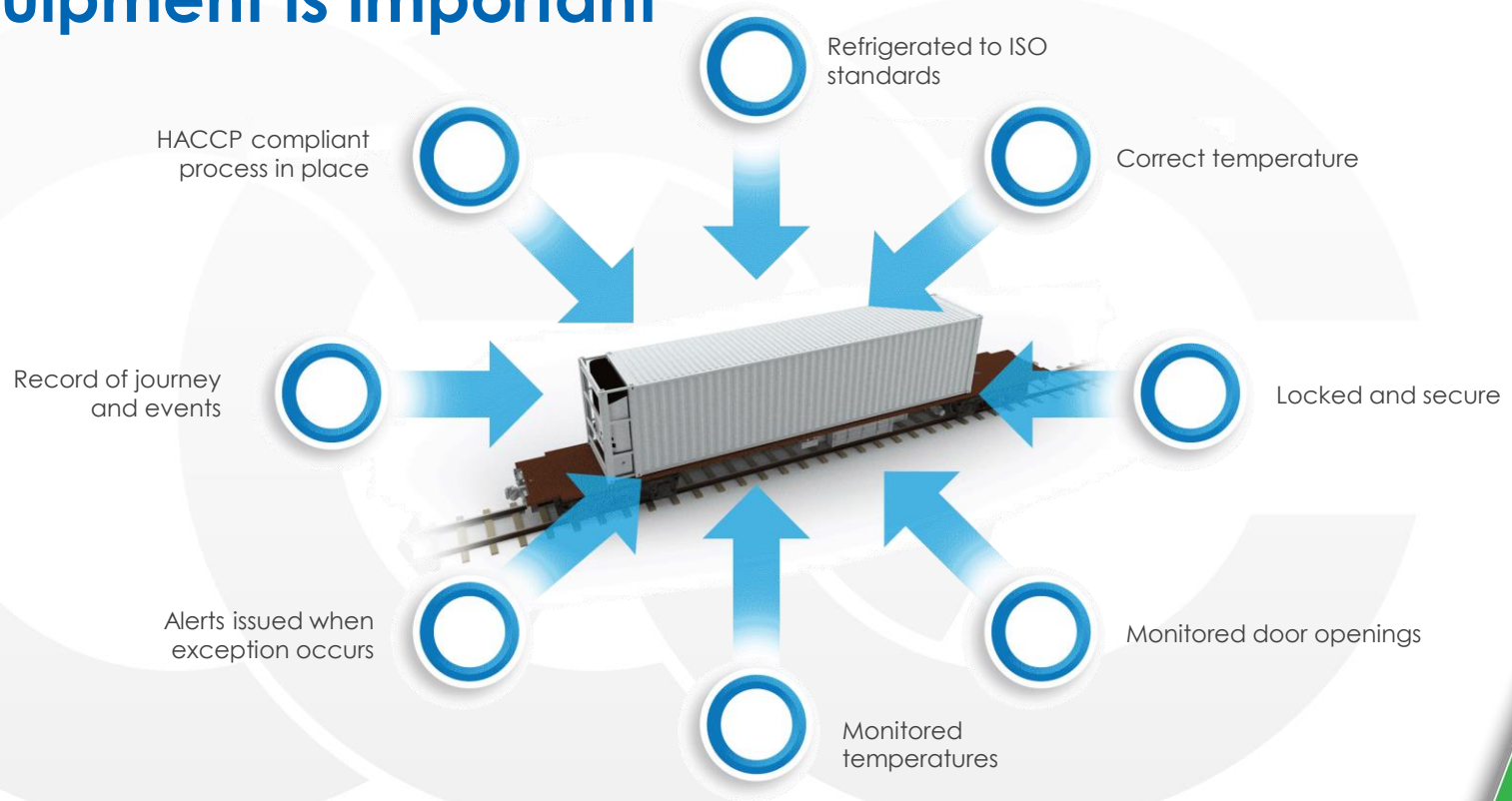
Equipment is important



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Equipment is important

Heat leakage

① **K coefficient of 1.5**

= 1.5 X 56 x 122.58

=10,296.72 watts

=10.30 kW

② **K coefficient of 0.8**

= 0.8 X 56 x 122.58

= 5,491.58 watts

= 5.49 kW

Example body

- 20 Pallets
- 63m²
- 12.5m x 2.1m x 2.4m
- 122.58m²

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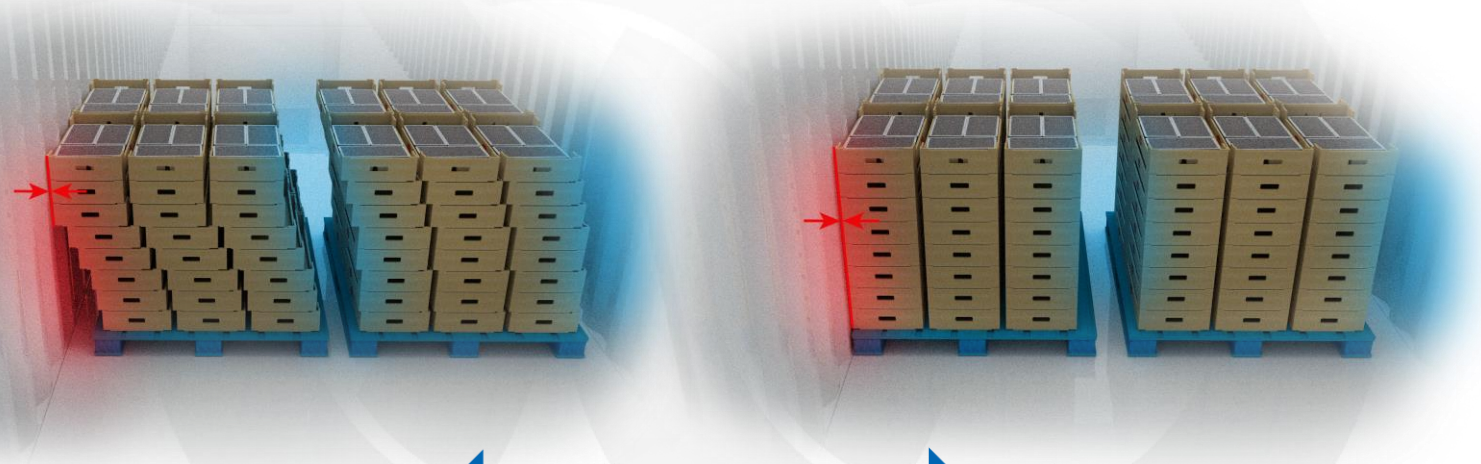
When things go wrong
Responsibility is unclear



Boxes touch the wall

Different problems, same result

Entire pallet touches the wall

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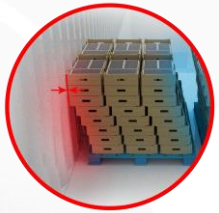
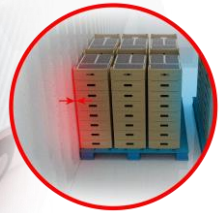
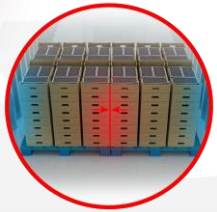
When things go wrong
Responsibility is unclear



Boxes touch the wall



Entire pallet touches the wall



Pallets are too close

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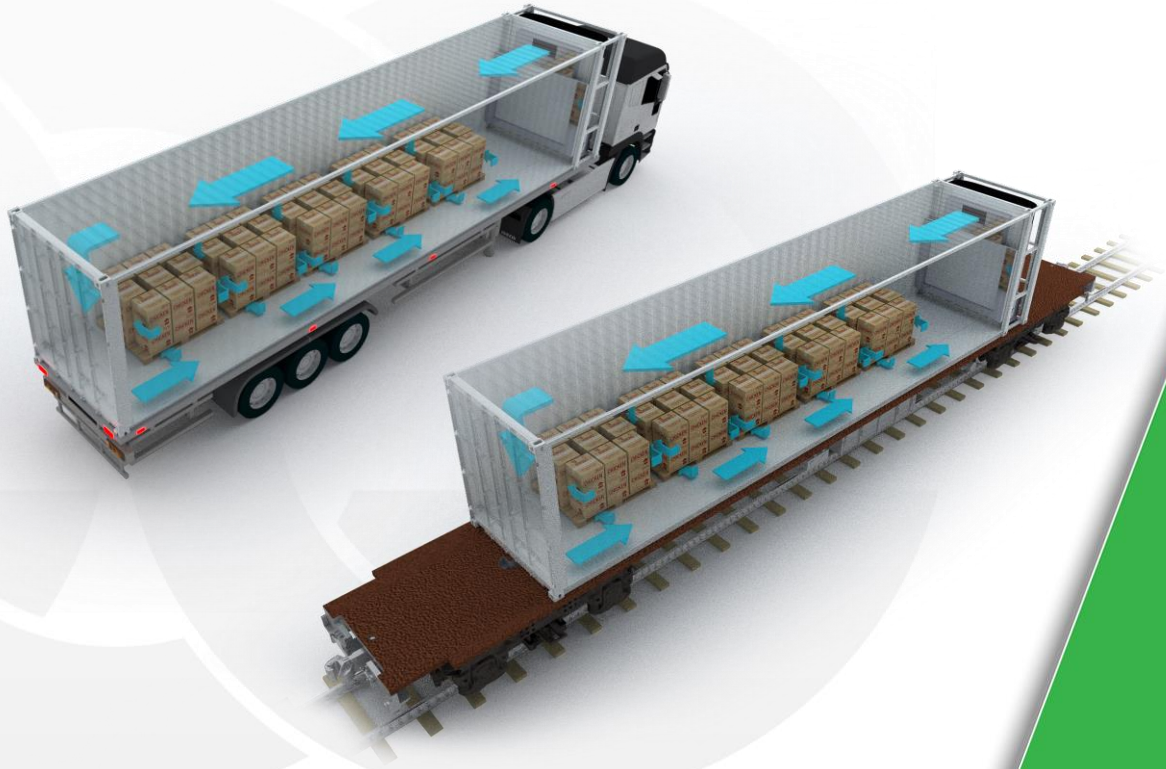
Air flow is important

- Good flow produces heat convection
- It is crucial for maintaining product temperature in transport
- Moving air is forced convection
- Still air is free convection



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Air flow is important

- Sufficient forced air convection occurs in IMC and trailer applications velocities > 0.5 m/s
- Inadequate forced air and free air convection can occur at the rear of an IMC/Trailer, or at velocities of 0.0 to 0.1 m/s

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Air flow is important

- Packaging, packing, stacking and wrapping play a role in air flow and product temperature compliance
- They are four different things
- Either can block airflow sufficiently to negate convection and introduce conduction
- Can eliminate the efficiency of good refrigeration

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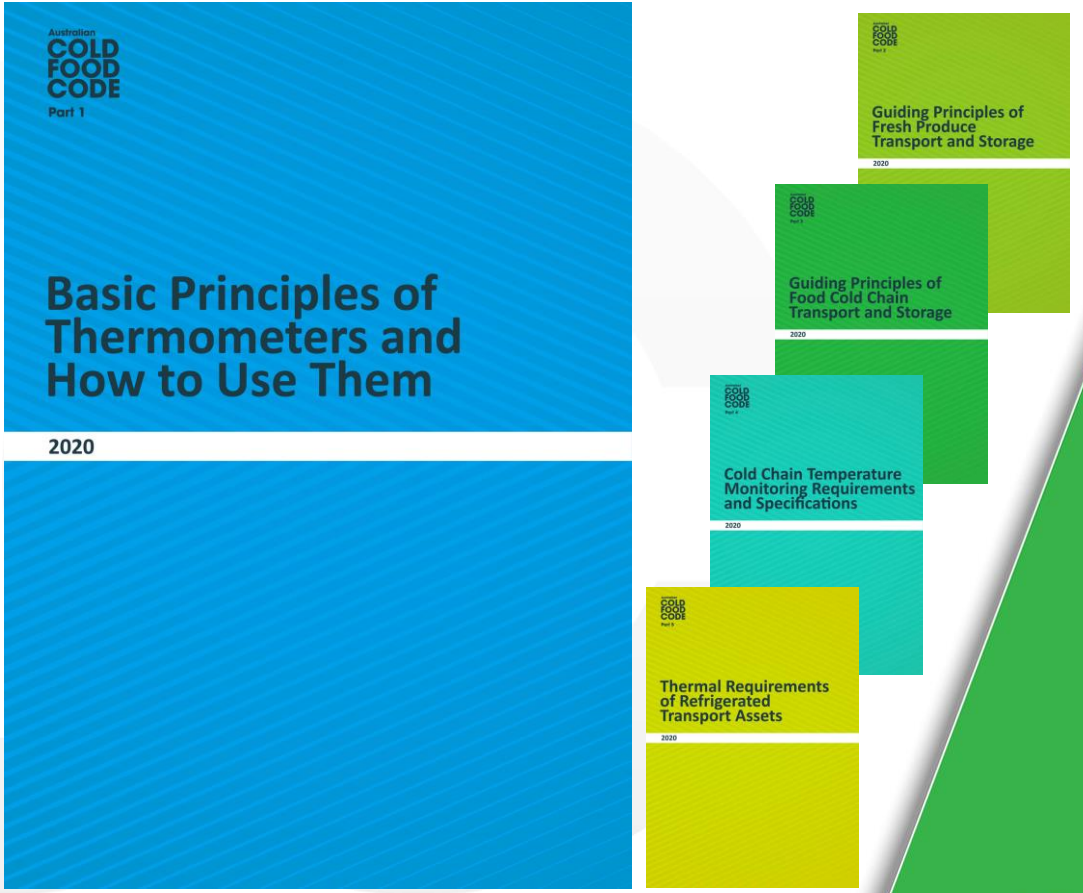
Cold Chain Professional Development Series

5 e-Module
Short Course

- The Cold Chain
- Heat and Temperature
- Introduction to Thermometers
- Temperature Measurement
- Thermometer Technology



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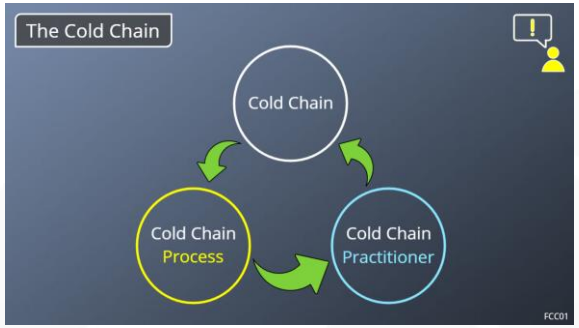
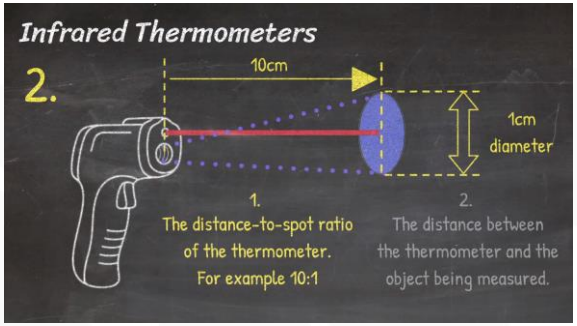
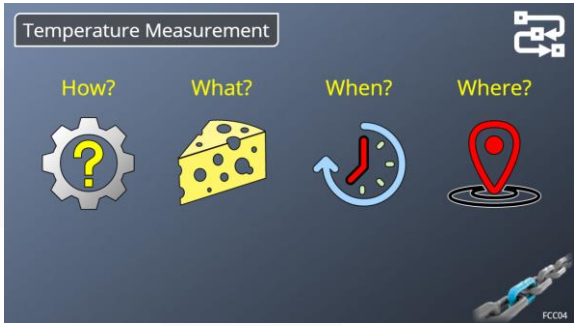
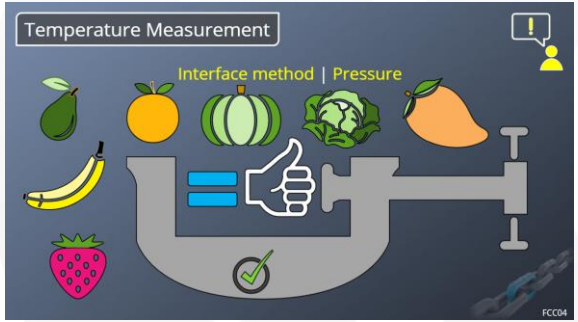
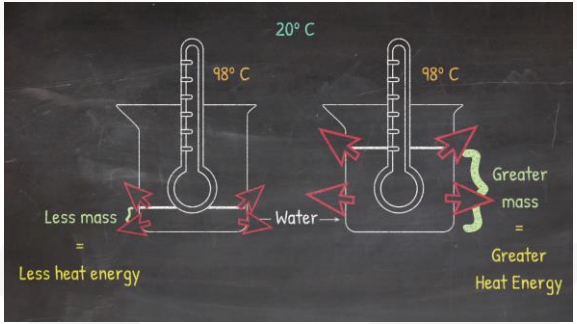




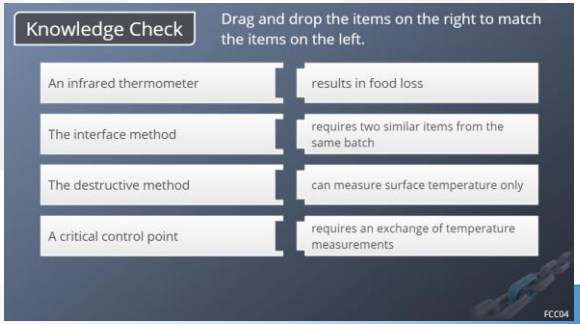






https://afccc.org.au/training.html

http://aipack.com.au/education/cold-chain-training-modules/



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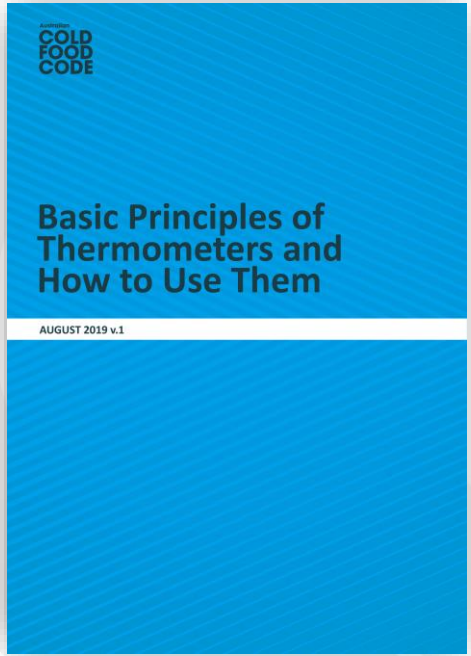
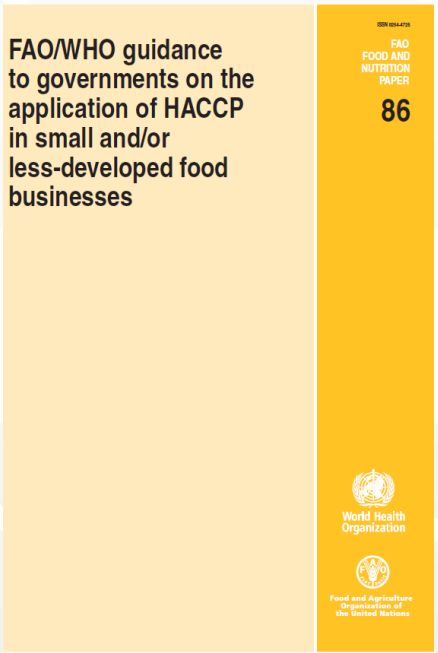
Further resources





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Thanks for listening