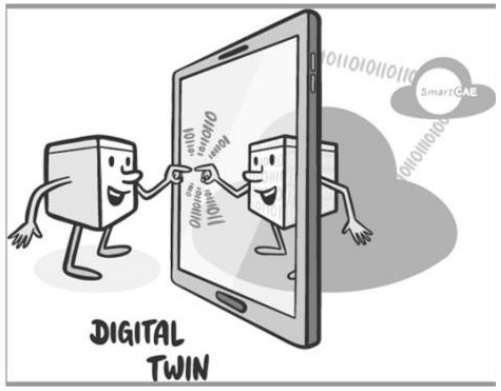
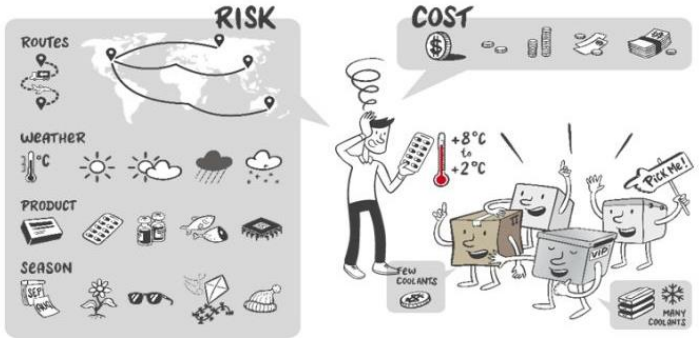
Digital Cold Chain Pioneers

How a Digital Cold Chain helps to make the Pharma Supply Chain more cost-efficient and greener



Reality in the Cold Chain



SmartCAE

SmartCAE

Digital Cold Chain Pioneers

Founded in 2002

Thermal engineering company, since 2014 focus on Temperature Controlled Logistics

Current customer base around the world 25 countries

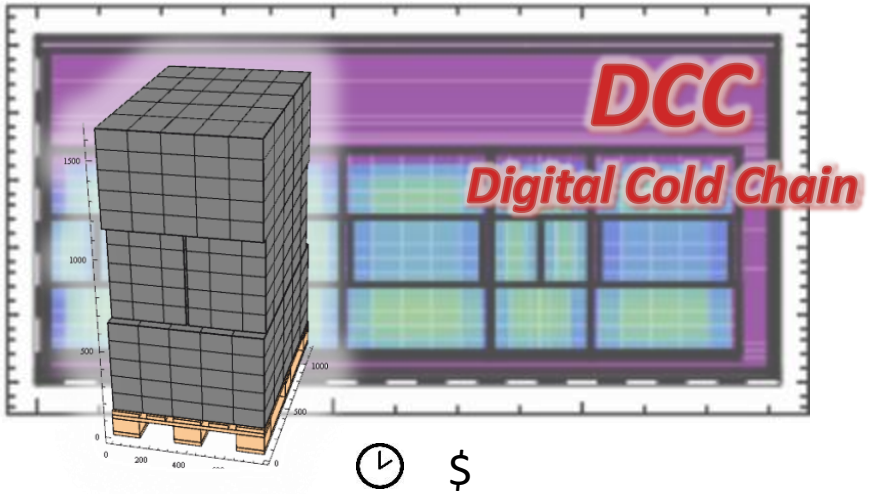
SmartCAE is the inventor of the Digital Cold Chain

- Pharma companies: 14 of the top 30 pharmas work with us
- Packaging companies: most of the global relevant companies

The **Digital Cold Chain** is an award-winning software platform for the simulation of Temperature Controlled Logistics

Where the idea came from

Digital Cold Chain Pioneers

Live	Lab	Digital
		
		
🕒🕒🕒 $$$	🕒🕒 $$	🕒 $

Technology Trend

Our Work Align with the Top 10 Trends

Digital Cold Chain Pioneers

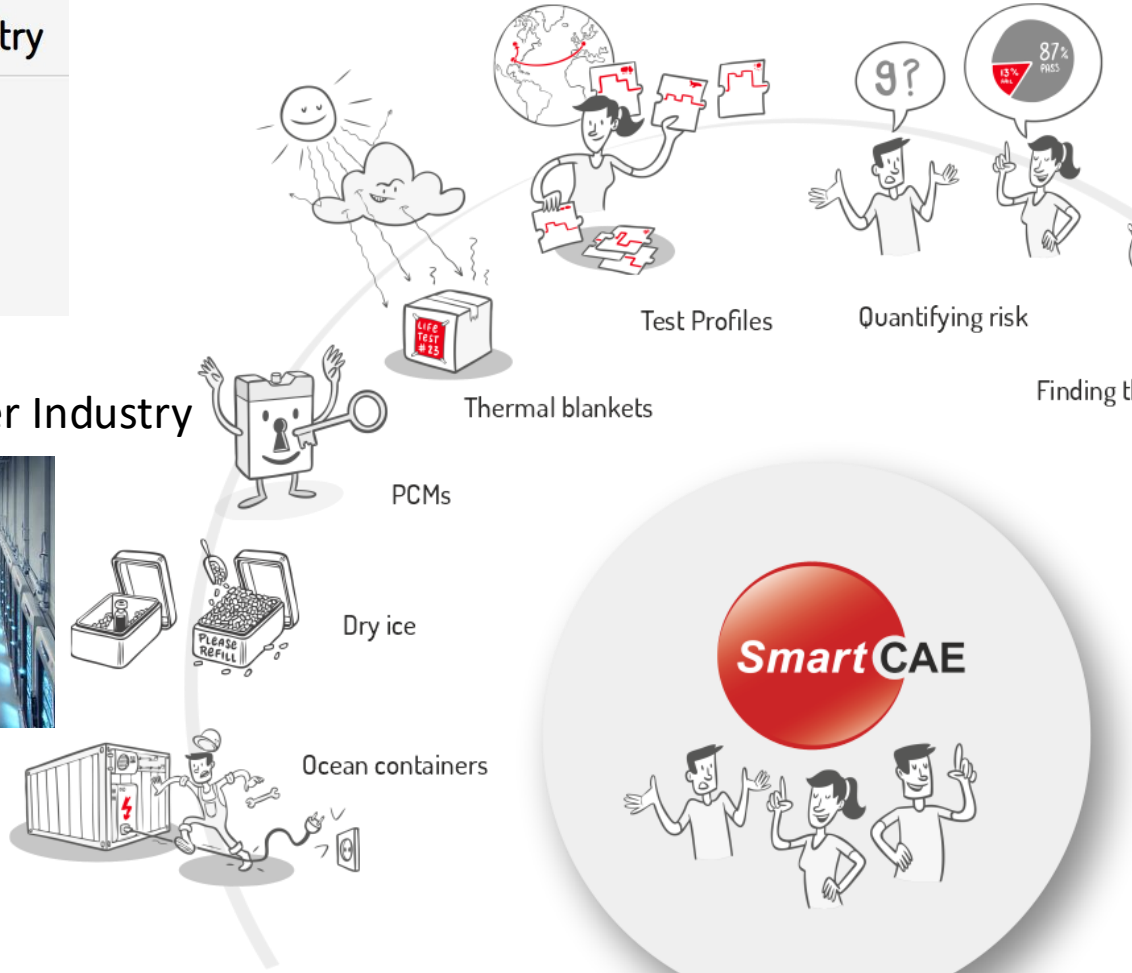
What does SmartCAE offer

Digital Cold Chain Pioneers

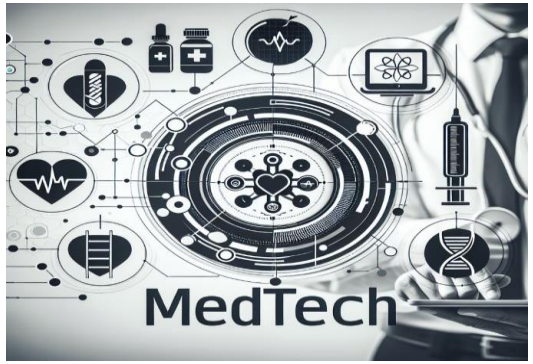
DCC Software Suite **DCC Simulation as a Service** **DCC Real Time Predictive Analytics**

Thermal Packaging Industry

Semiconductor& other Industry



Pharmaceutical Industry



Perishables Industry

Which problem we solve?

Digital Cold Chain Pioneers

Season

Mode of transportation

Origin

Destination

Product Temperature Range

Which protection needed?
Total Cost of Ownership
Carbon Footprint

Risk Assessment

fast!

efficient!

accurate!

compliant!

Which works? Yes / No

Digital Cold Chain

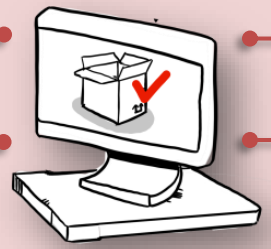
Digital Twin in the Cold Chain for Planning and Execution

Digital Cold Chain Pioneers

Box

Lane

Digital Twin



Planning

Historical data

Forecast data

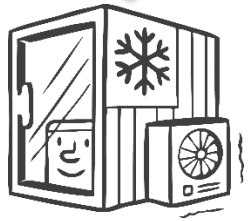
Execution

100% Pass

90% Pass

Minimize Risk & Reduce Costs

+10% saved



Live correction

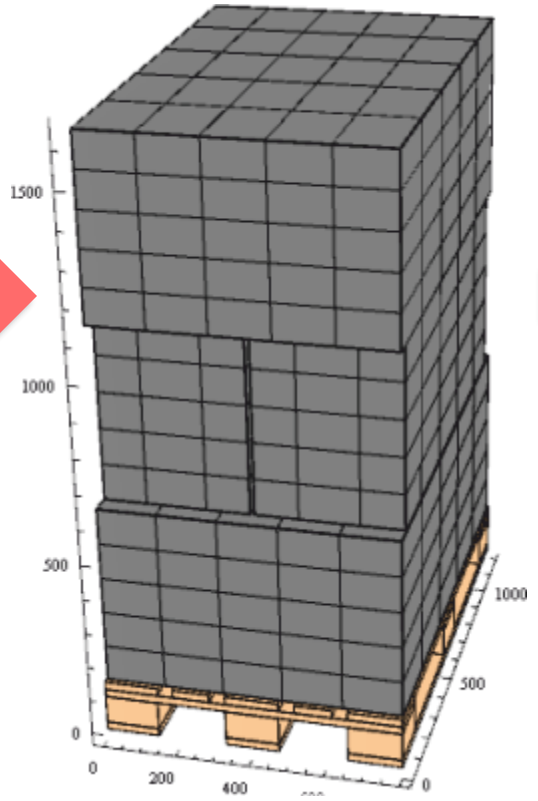
Digital Twin: Box

SmartCAE
Digital Cold Chain Pioneers

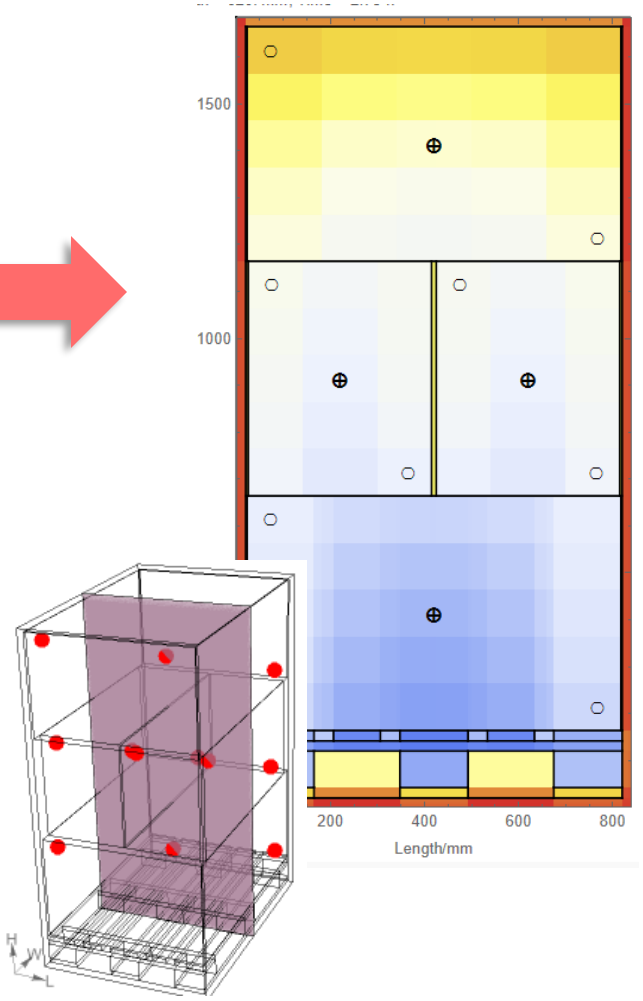
Digital Box

Physical Shipper

Digital Twin



Thermal model



Digital Twin: Box – what can be modeled

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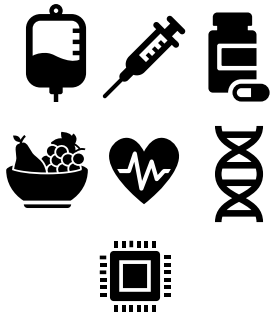
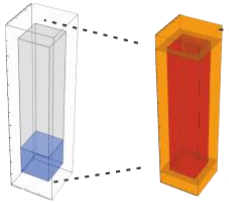
Digital Cold Chain Pioneers

Digital Box

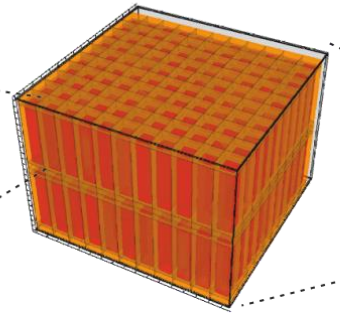
Products



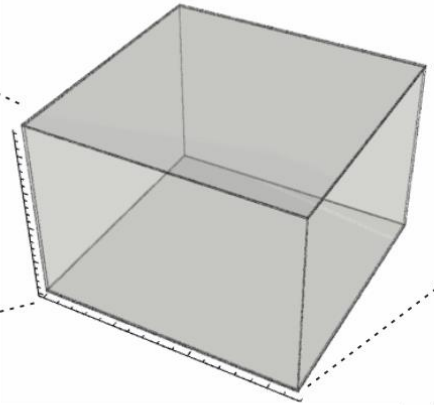
Unit of sale



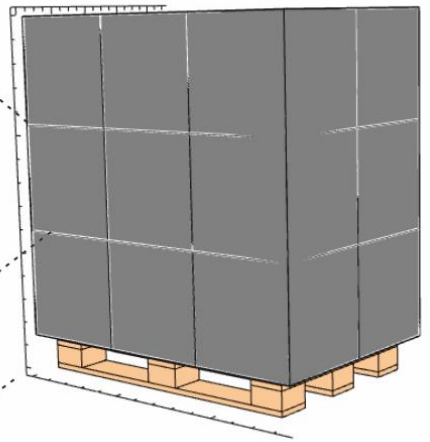
Units package

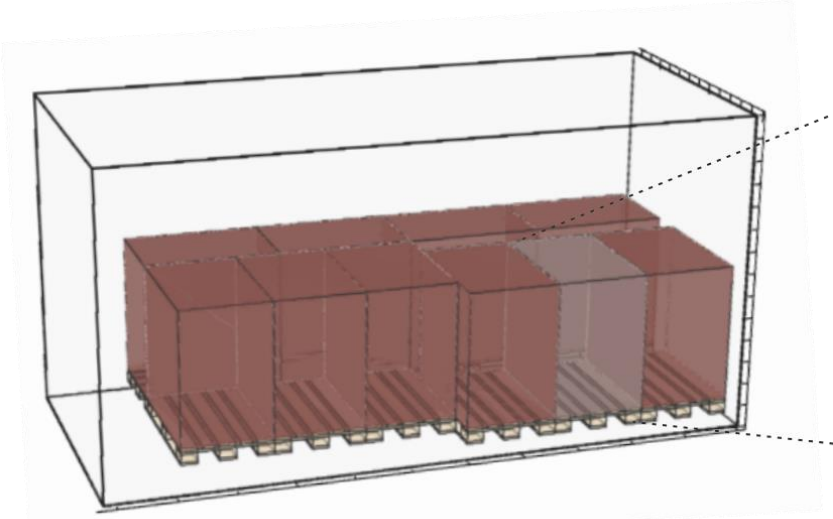


Product box

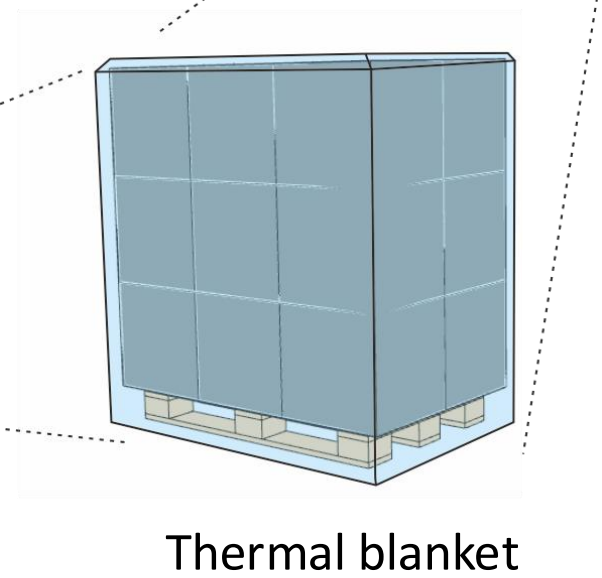


Pallet





Reefer



Thermal blanket

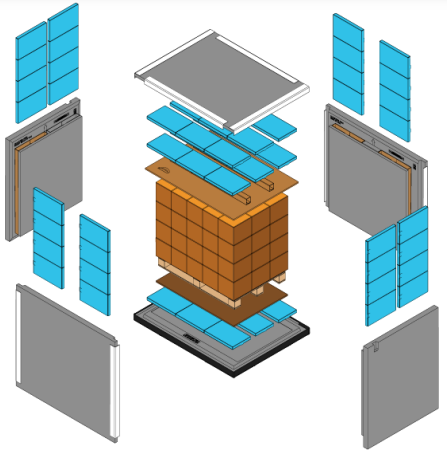
SmartCAE

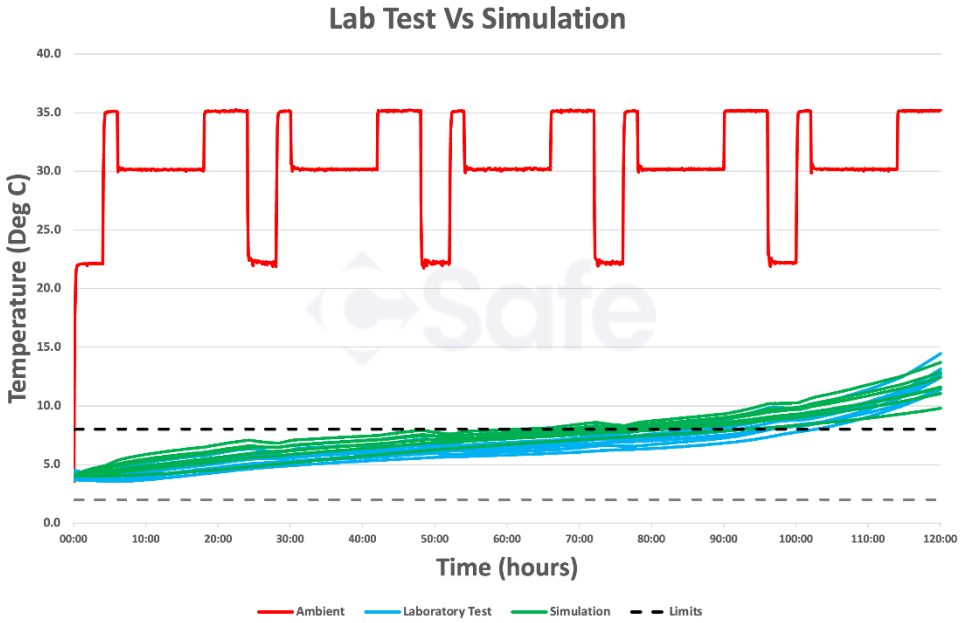
Digital Cold Chain Pioneers

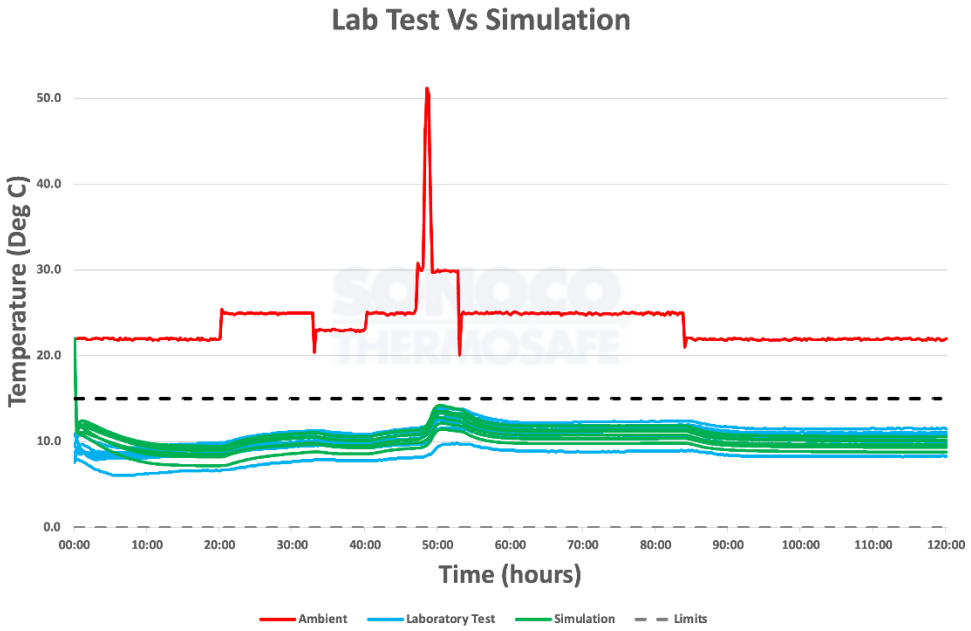
How close is simulation to reality?

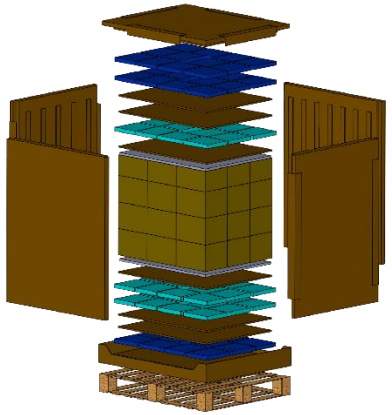
Pallet Shipper Simulation

Digital Cold Chain Pioneers





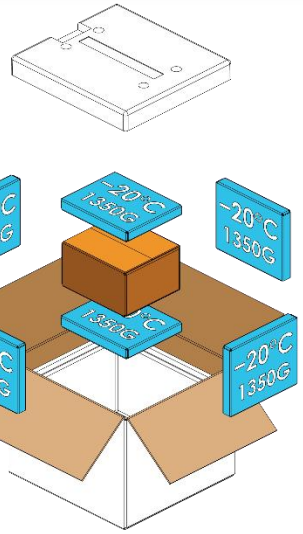


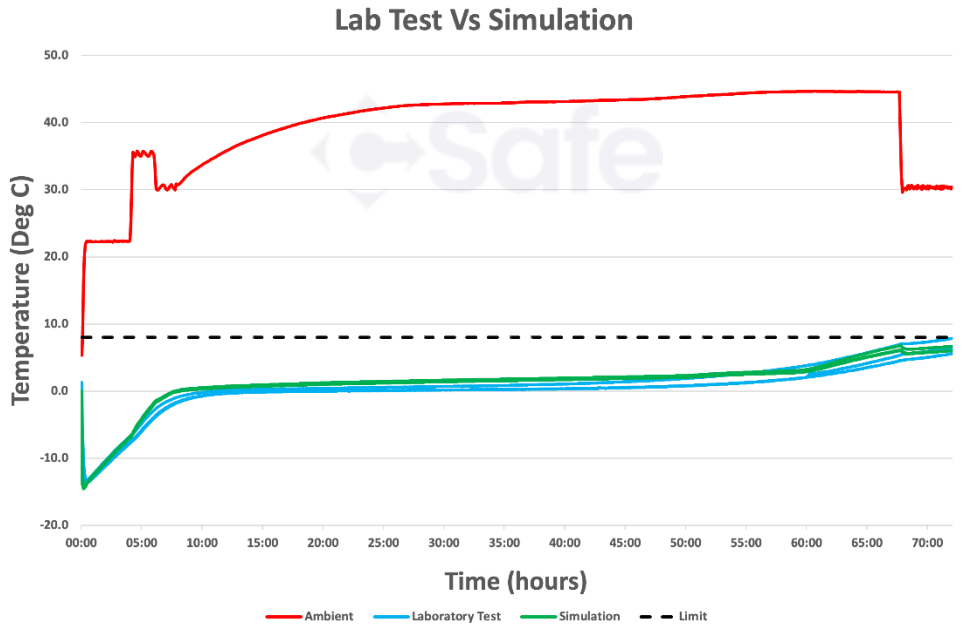


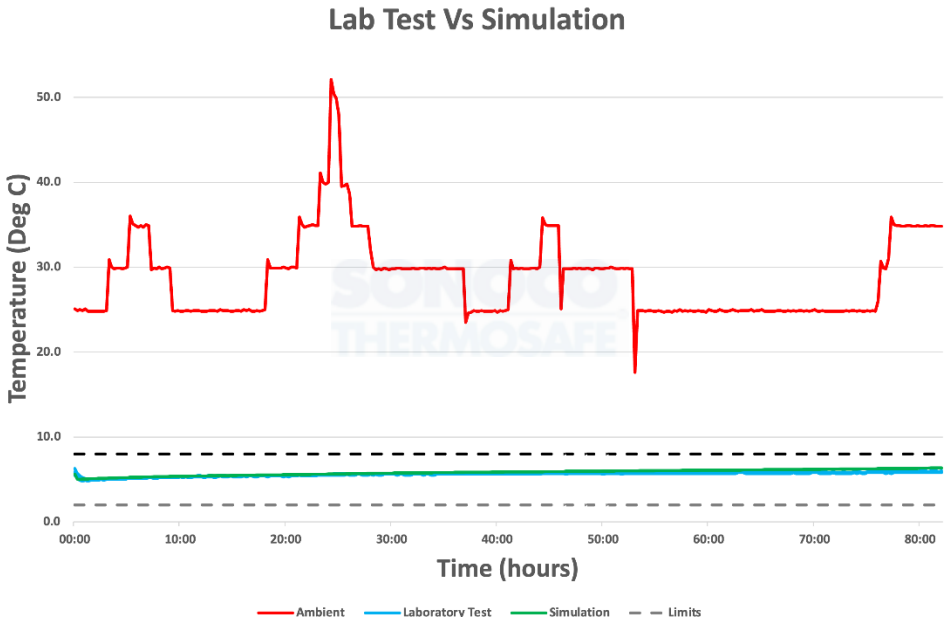
Source ISTA Conference 23 Amsterdam

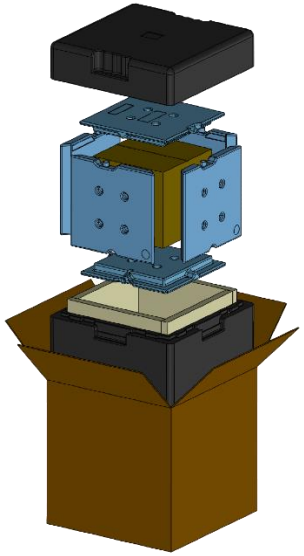
Parcel Shipper Simulation

Digital Cold Chain Pioneers









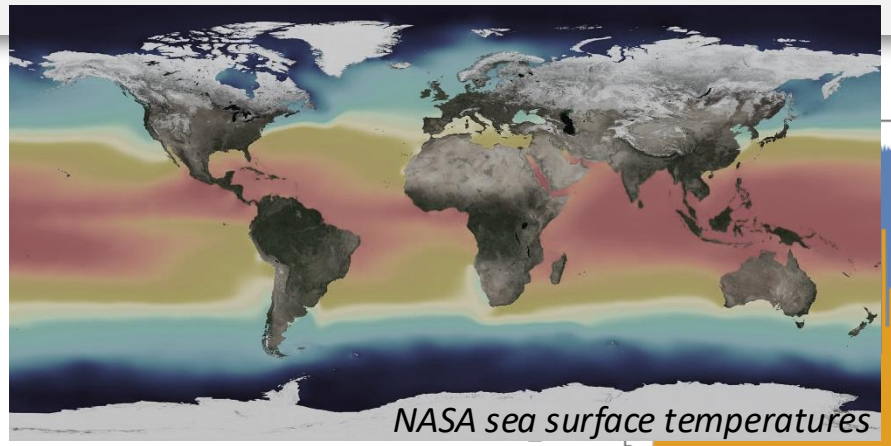
Source ISTA Conference 23 Amsterdam

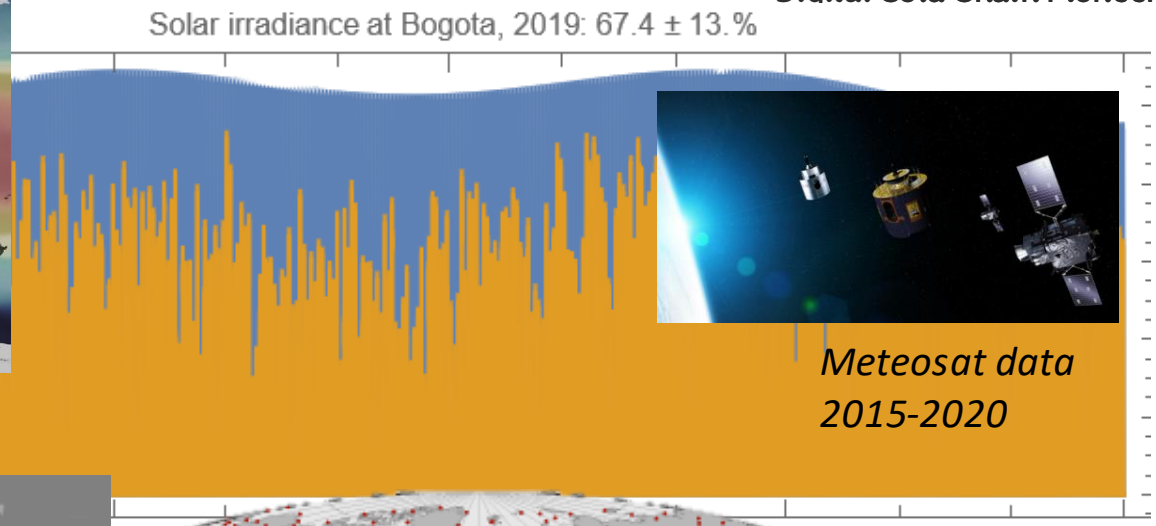
Digital Twin: Lane

SmartCAE
Digital Cold Chain Pioneers

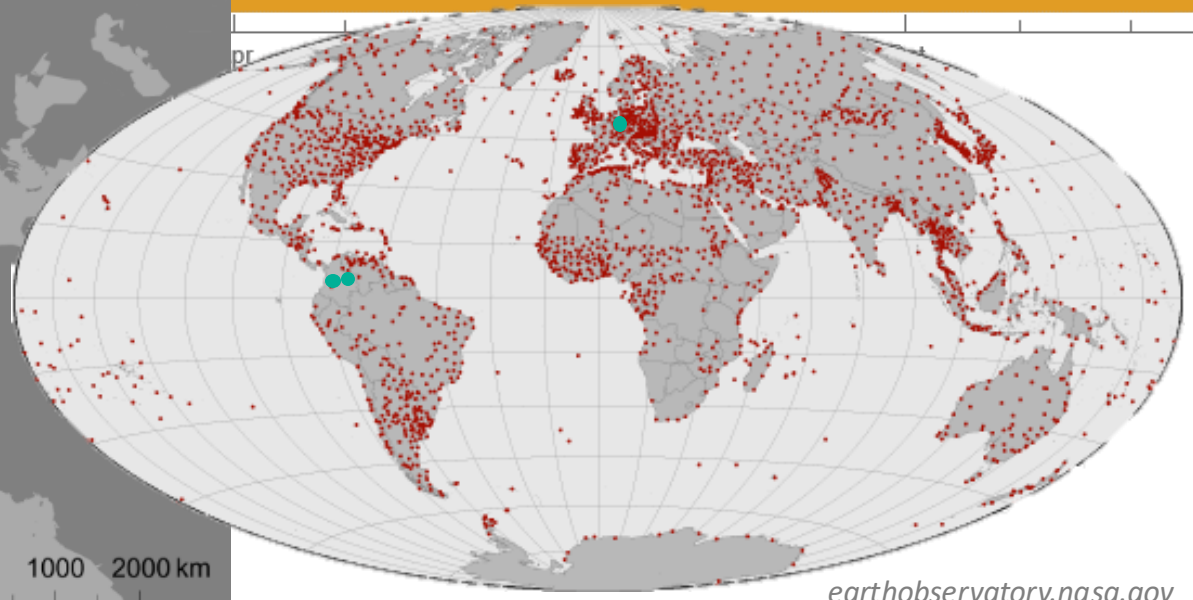
Digital Box

Digital Lane


NASA sea surface temperatures



Meteosat data
2015-2020


earthobservatory.nasa.gov

Weather Stations

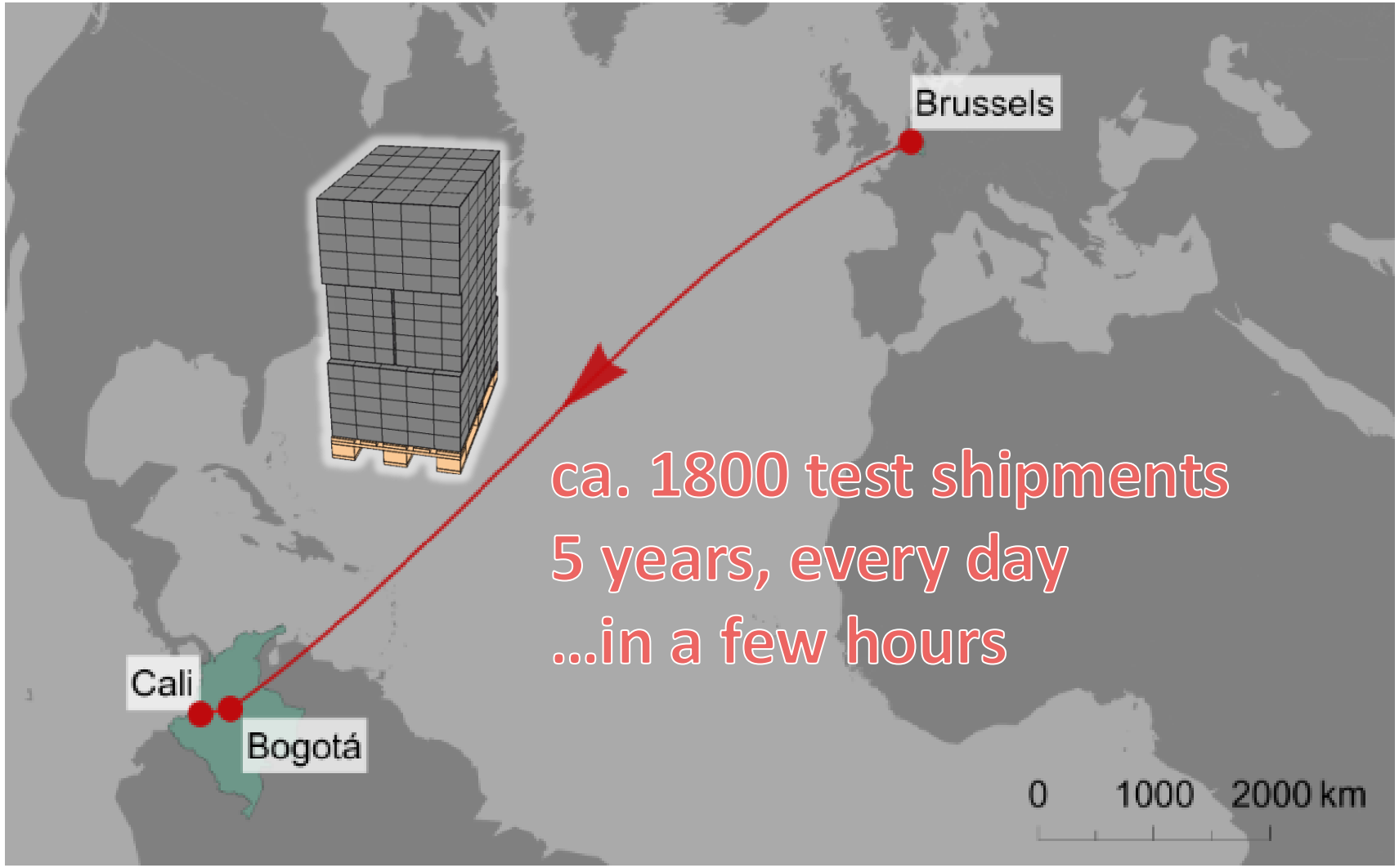
Digital Twin: Lane Risk

SmartCAE
Digital Cold Chain Pioneers

Digital Box

Digital Lane

Digital Risk



Digital Twin: Lane Risk Historical

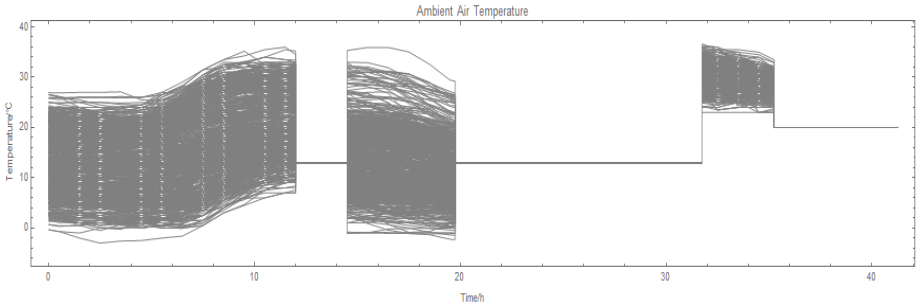
Digital Cold Chain Pioneers

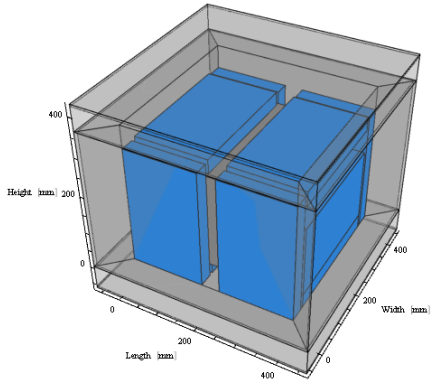
Digital Box

Digital Lane

Digital Risk

Historical lane temperature profiles





●	PU All-Seasons
●	VIP All-Seasons
●	EPS All-Seasons
●	PU Winter
●	PU Summer

How many days would have led to **excursions**?

Digital Twin: Lane Risk Historical

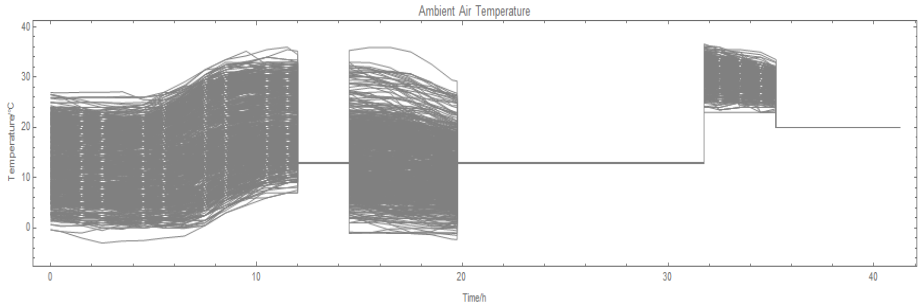
SmartCAE
Digital Cold Chain Pioneers

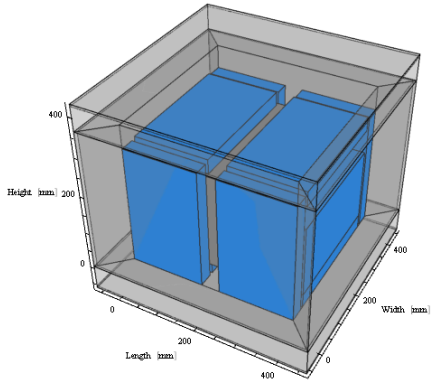
Digital Box

Digital Lane

Digital Risk

Historical lane temperature profiles





●	PU All-Seasons
●	VIP All-Seasons
●	EPS All-Seasons
●	PU Winter
●	PU Summer

Historical probability for no temperature excursion

	packaging	#	no excursions	cold excursions	hot excursions	hot&cold excur.
1	Packout–All–Season	462	100.0%	0.0%	0.0%	0.0%
2	Packout–All–SeasonPU	462	100.0%	0.0%	0.0%	0.0%
3	Packout–All–SeasonVIP	462	100.0%	0.0%	0.0%	0.0%
4	Packout–Summer	460	98.7%	1.3%	0.0%	0.0%
5	Packout–Winter	459	4.1%	0.0%	95.9%	0.0%

Risk Mitigation
Choose the best box or combination of boxes

Digital Twin: Predictive Lane Risk : Next Days

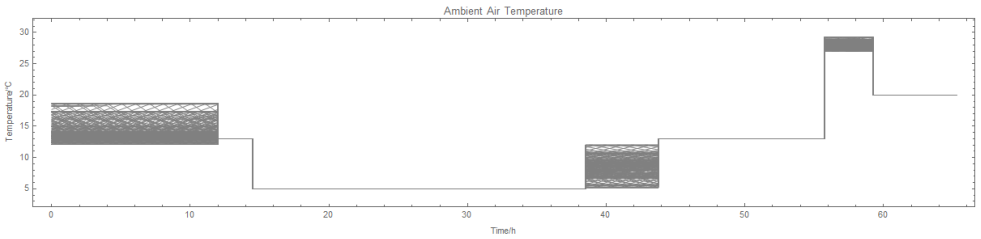
Digital Cold Chain Pioneers

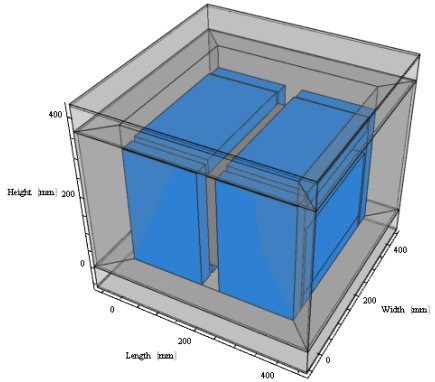
Digital Box

Digital Lane

Digital Risk

Predicted lane temperature profiles





●	PU All-Seasons
●	VIP All-Seasons
●	EPS All-Seasons
●	PU Winter
●	PU Summer

When do you have the highest risk of **excursions**?

Digital Twin: Predictive Lane Risk : Next Days

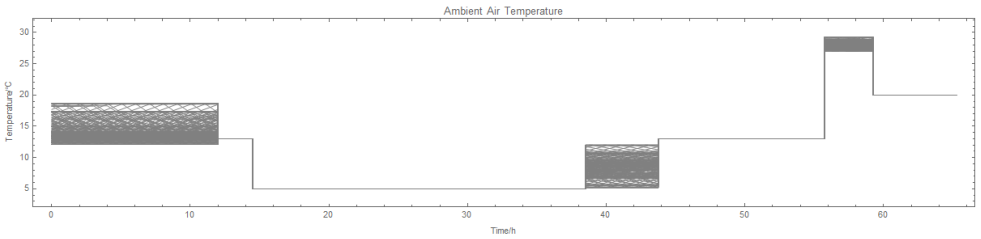
Digital Cold Chain Pioneers

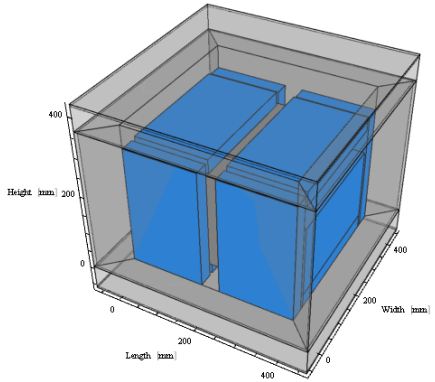
Digital Box

Digital Lane

Digital Risk

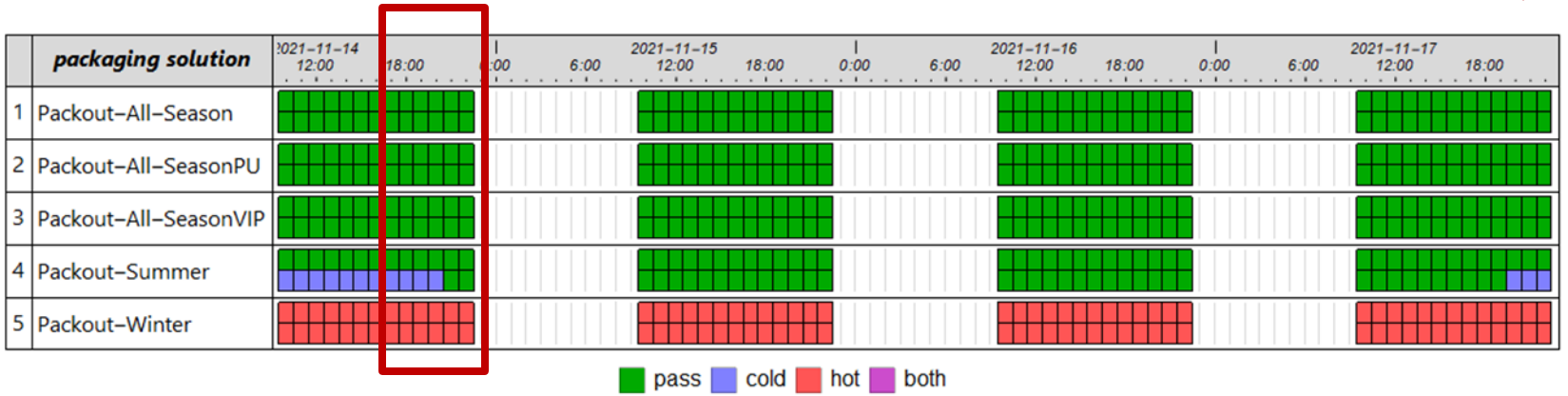
Predicted lane temperature profiles





●	PU All-Seasons
●	VIP All-Seasons
●	EPS All-Seasons
●	PU Winter
●	PU Summer

Pass and fail
for different boxes and dates



Digital Twin: Predictive Lane Risk : Next Days

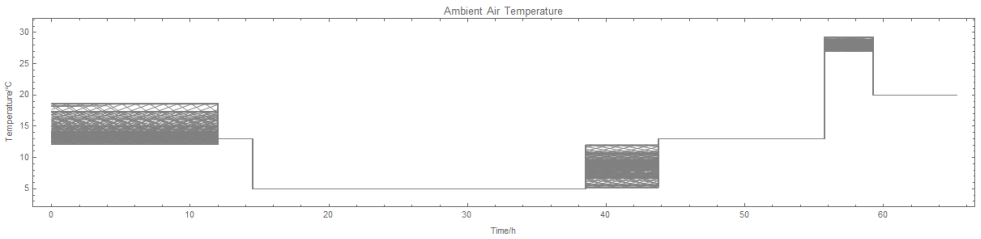
SmartCAE
Digital Cold Chain Pioneers

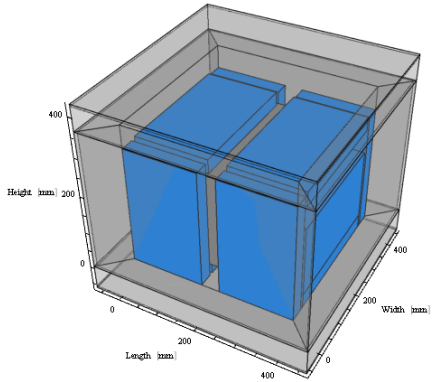
Digital Box

Digital Lane

Digital Risk

Predicted lane temperature profiles





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Pass and fail
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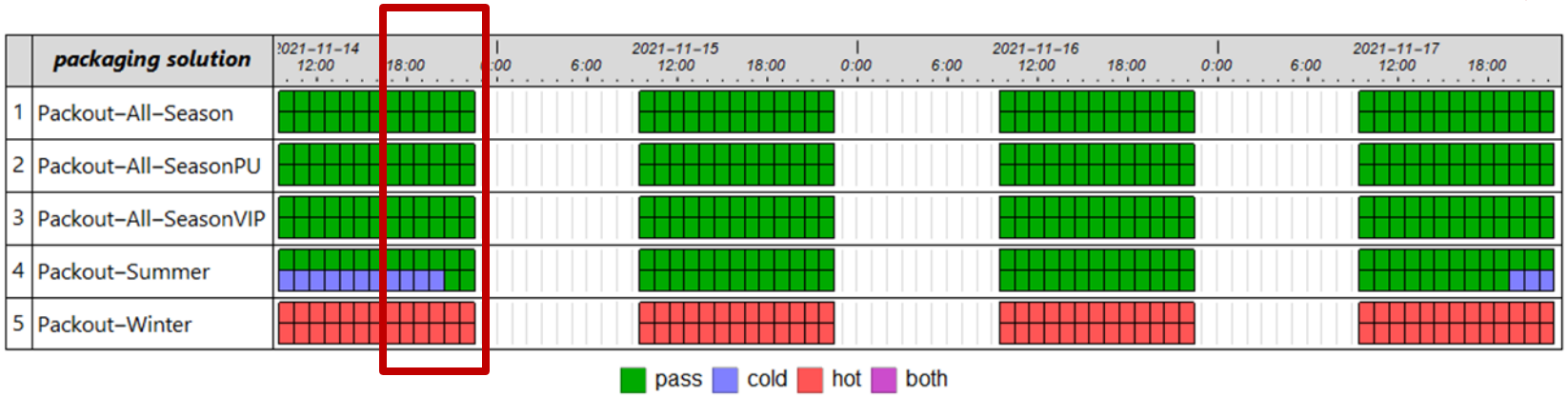


Risk Mitigation
Choose the best box and starting time

Digital Twin: Predictive Lane Risk Live

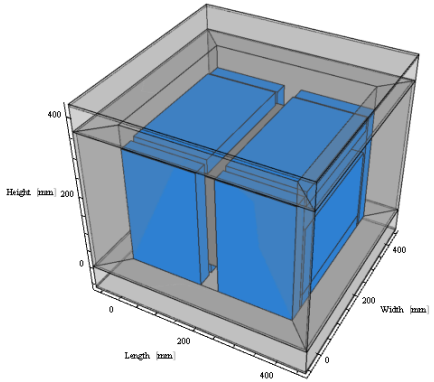
Digital Cold Chain Pioneers

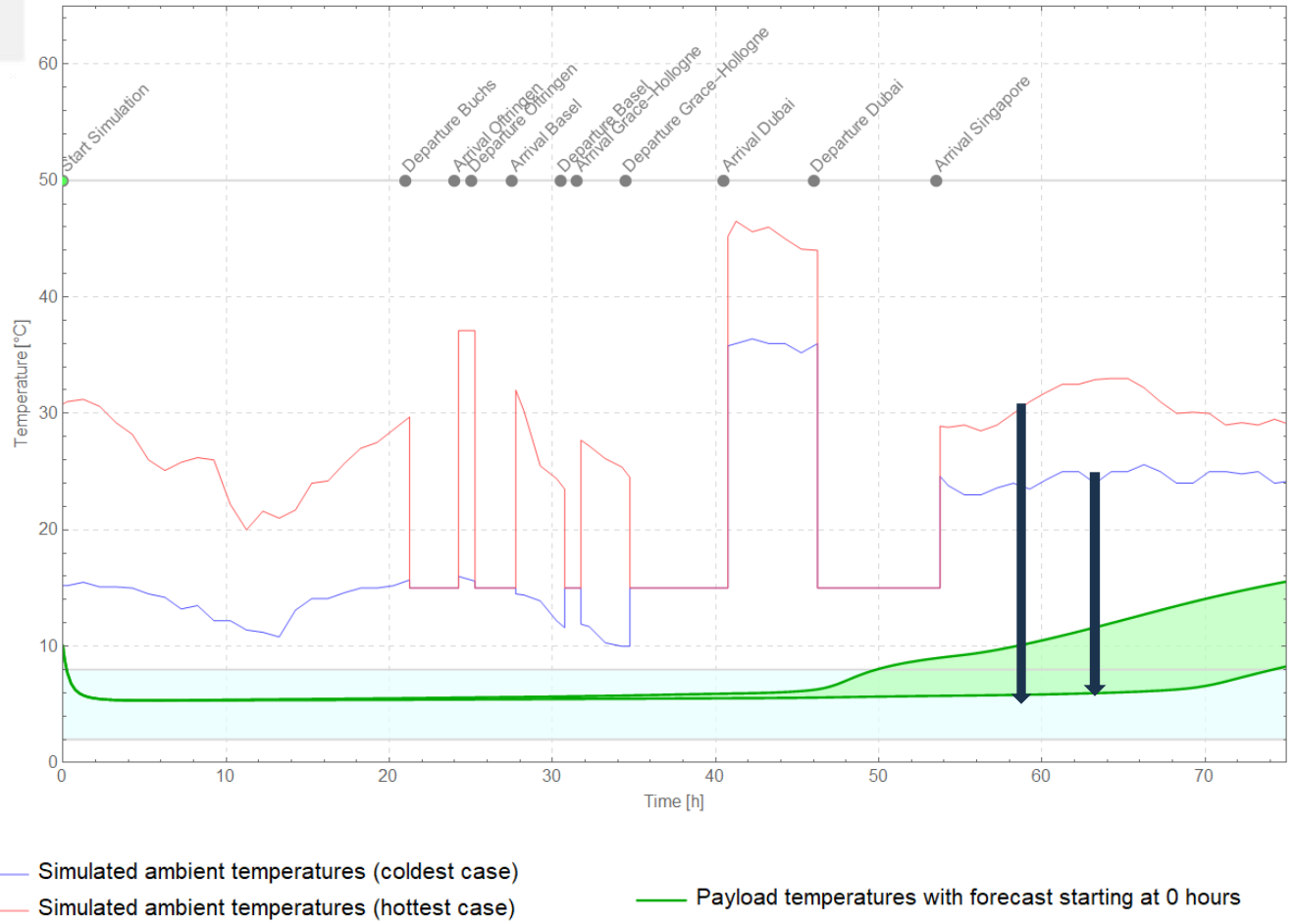
Digital Box

Digital Lane

Digital Risk

Start Lane





Digital Twin: Predictive Lane Risk Live

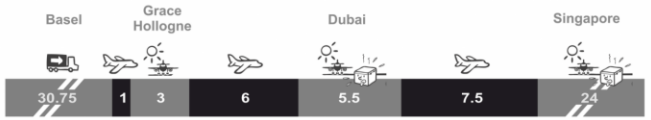
Digital Cold Chain Pioneers

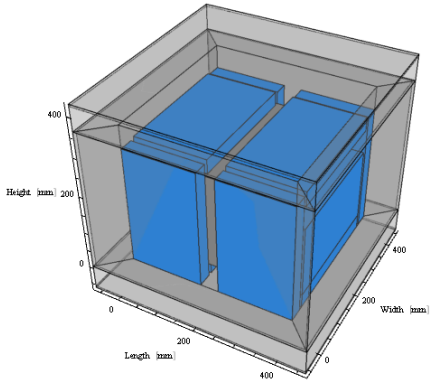
Digital Box

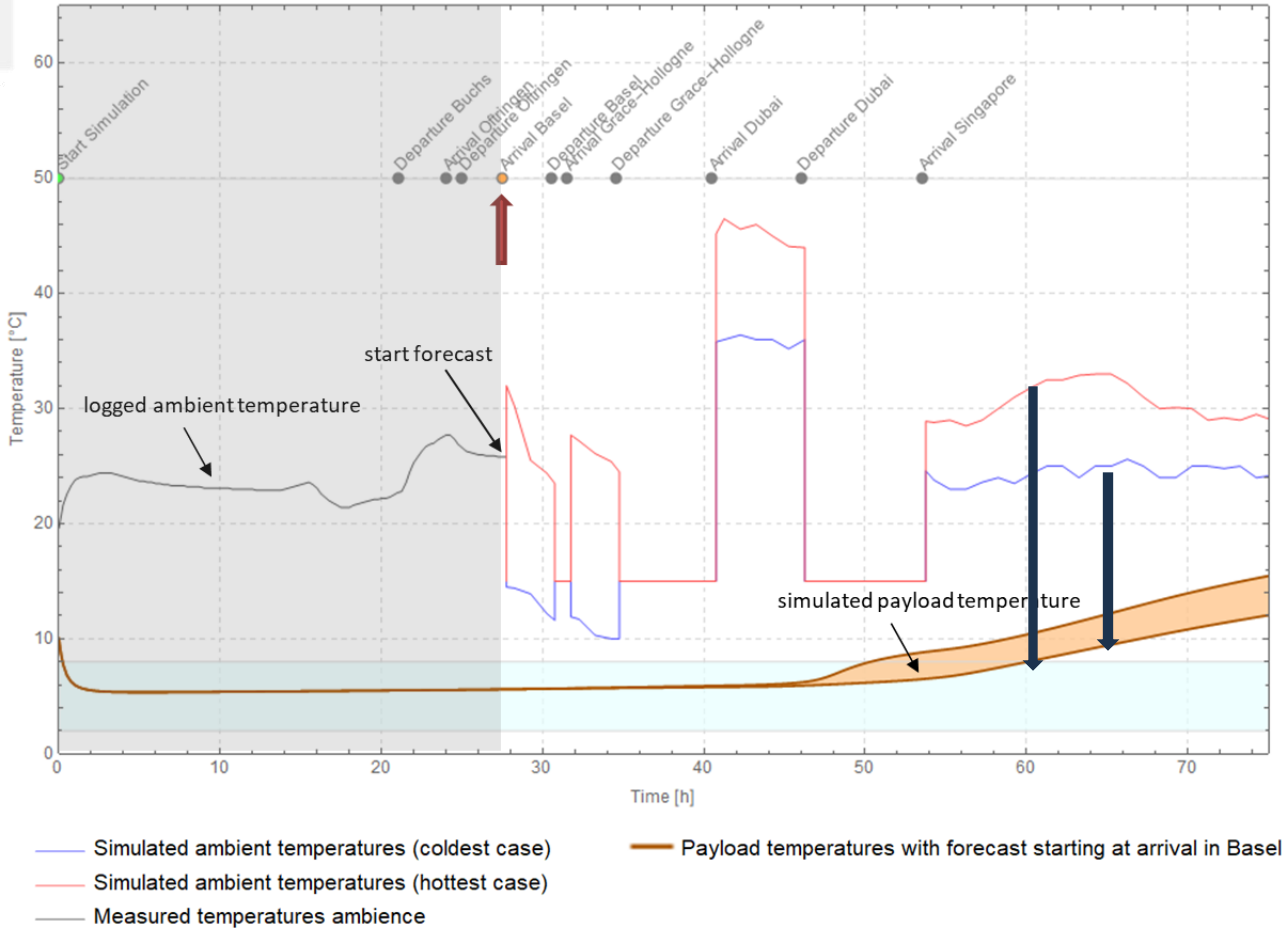
Digital Lane

Digital Risk

Start Lane







Digital Twin: Predictive Lane Risk Live

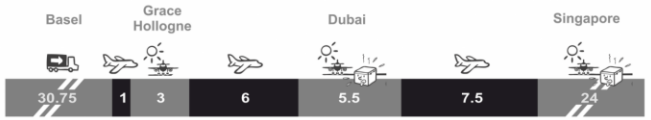
Digital Cold Chain Pioneers

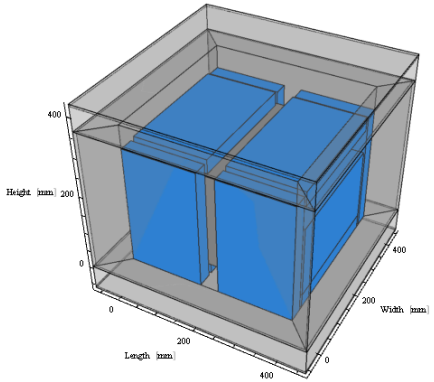
Digital Box

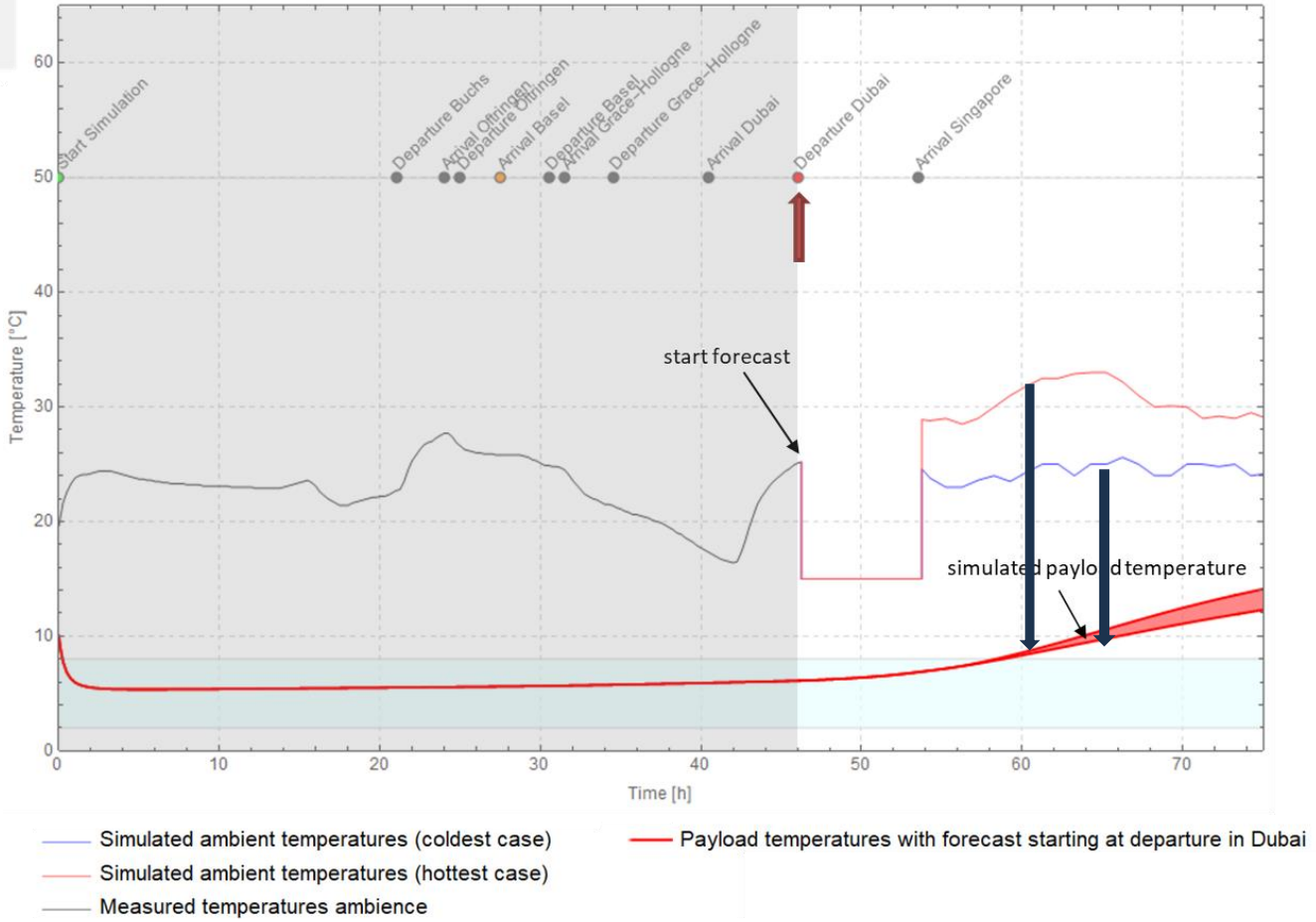
Digital Lane

Digital Risk

Start Lane

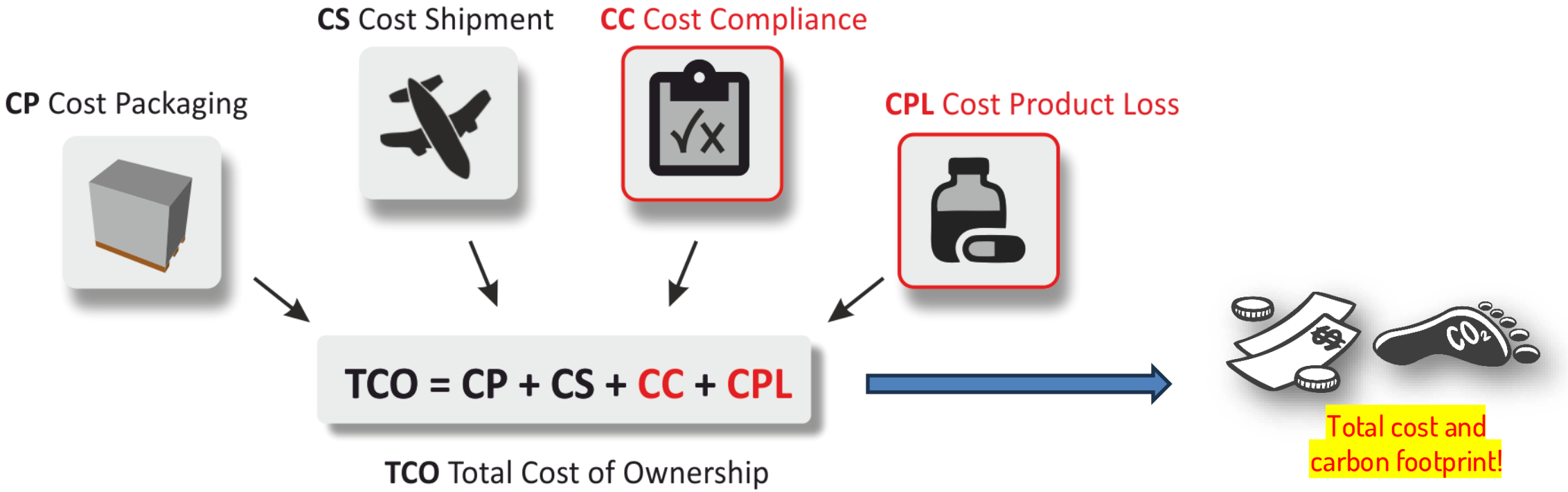


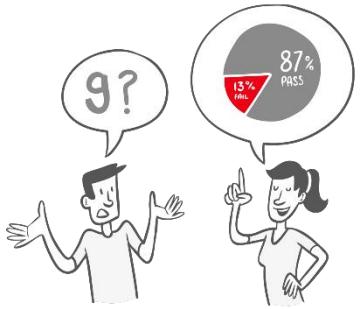




How to calculate Total Cost of Ownership?

Total Cost of Ownership in Temperature Controlled Logistics



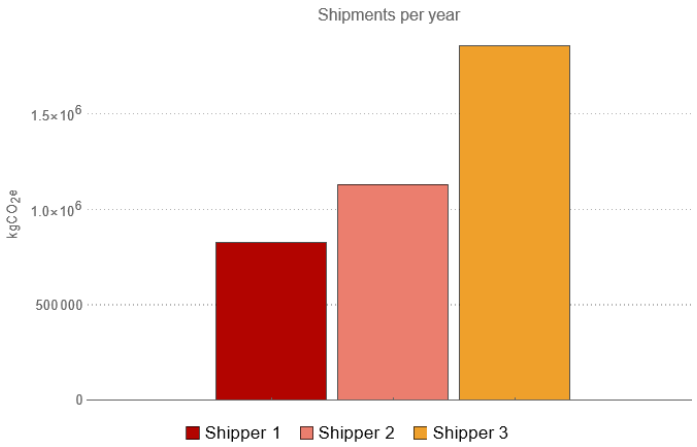


Digital Cold Chain can determine the unknown factors using thermal simulation before doing any physical shipment!
Speed up the lane risk assessment from weeks to days

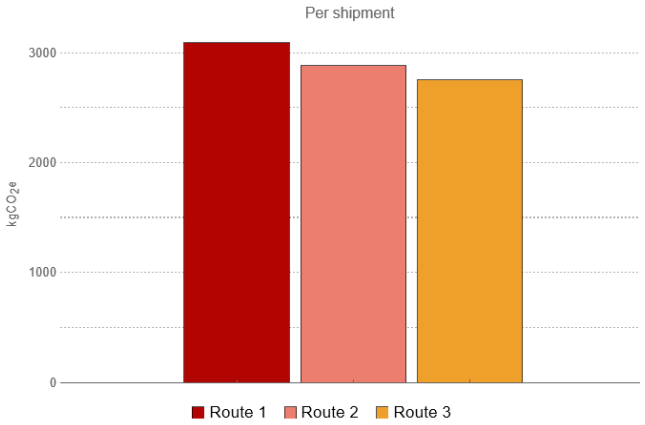
Carbon footprint calculations

Digital Cold Chain Pioneers

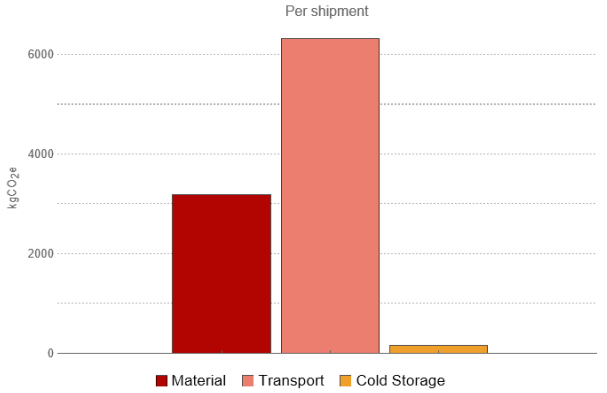
Package comparison



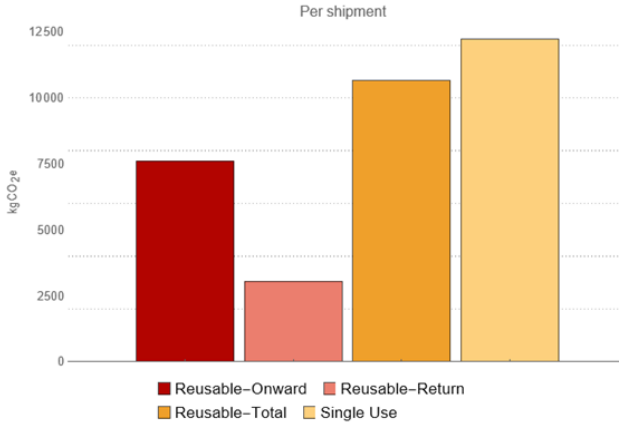
Route and lane comparison



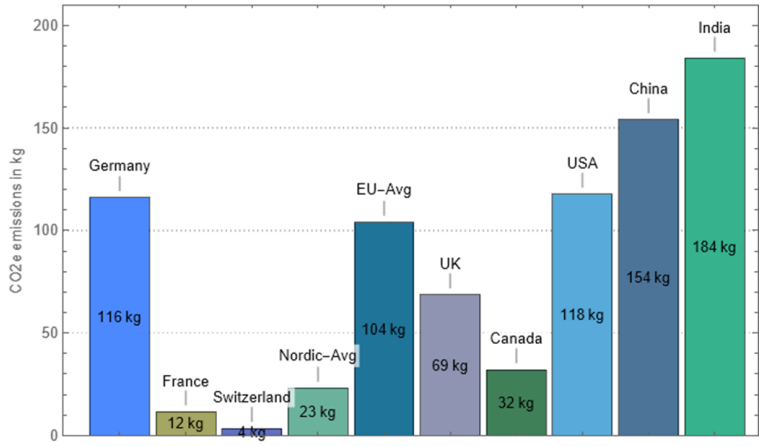
CO_2e contribution breakdown



Single use and reuse shippers with return



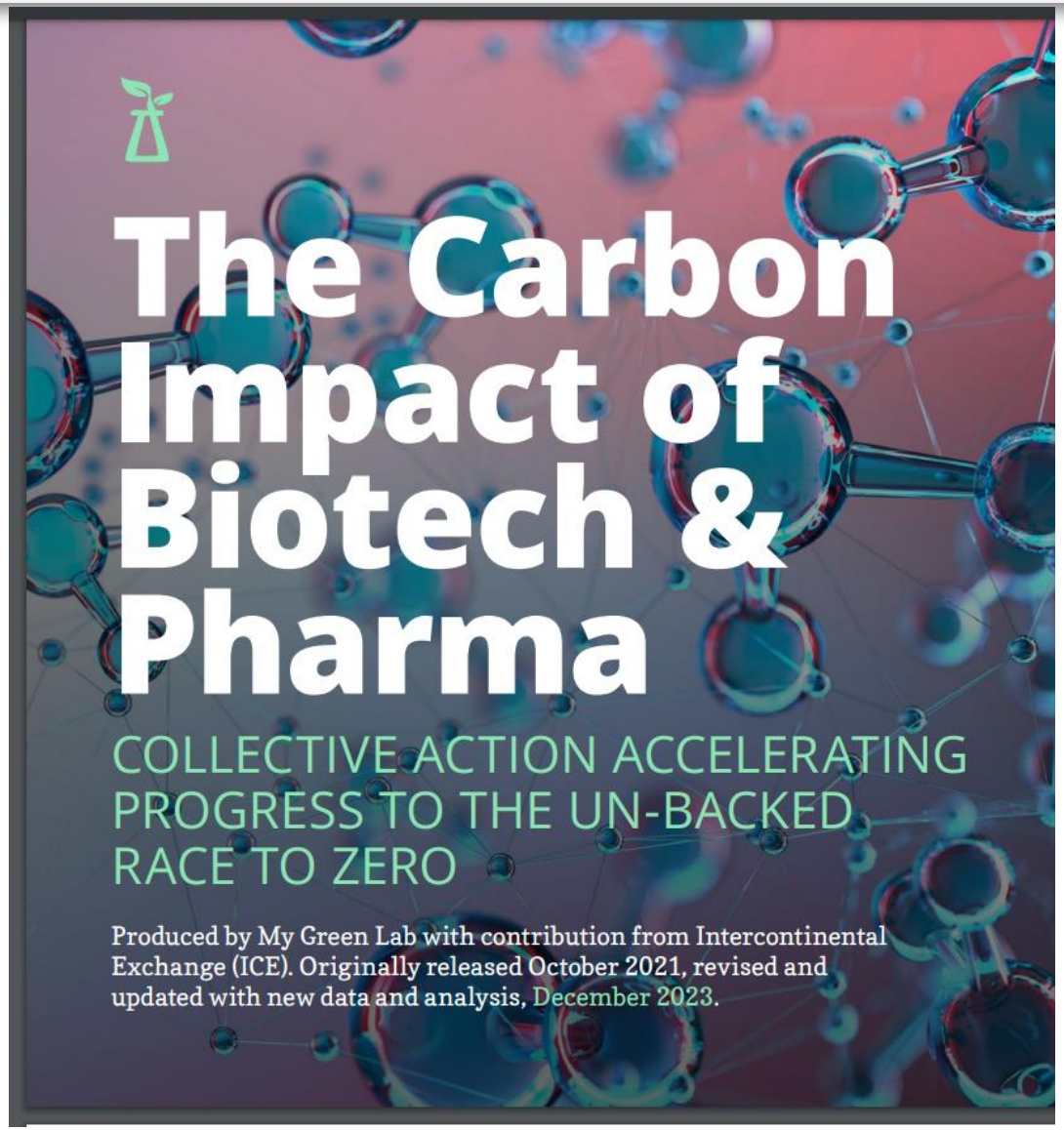
CO2e from Grid - Comparison



Sources: GLEC Framework and others

Is pharma-supply chain ready for the change?

Carbon Footprint



Some Key Facts about BioPharma industry

Total global emissions grow from 3.9% in 2021 to 5% in 2022

Total climate footprint is 193 million metric tons of carbon dioxide equivalent (CO_2e).

71% of total emissions are derived from the Healthcare supply chain.

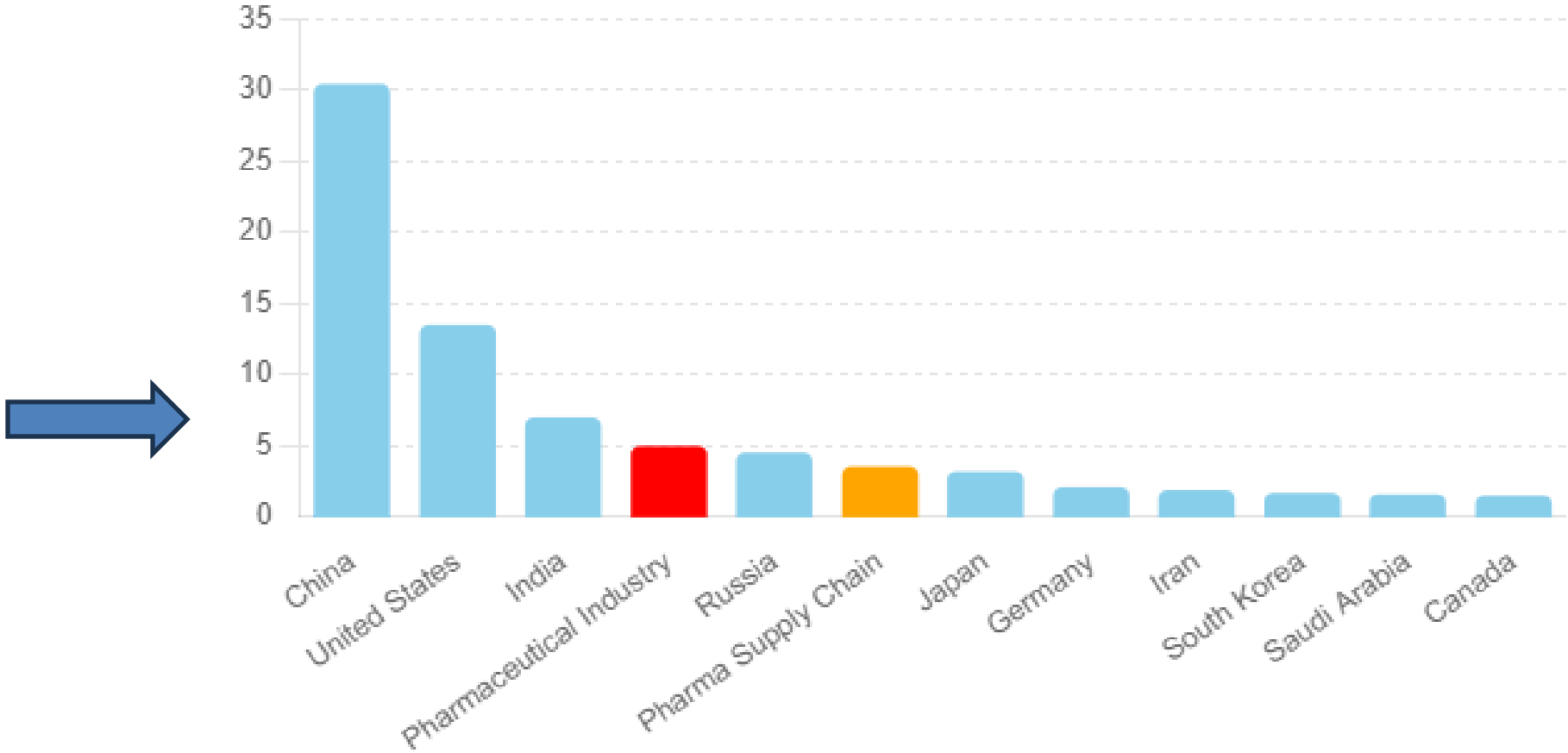
Market grow from USD $1.0 trillion in 2021 to $3.9 trillion by 2030, with a 13.9% CAGR

Some Key Facts about BioPharma industry

Digital Cold Chain Pioneers

55% more greenhouse gas emissions compared to the automotive industry with emissions of 48.55 tonnes of CO2 equivalent per million dollars compared to 31.4 tonnes in the automotive sector

If Pharma were a country



How BioPharma Supply Chain can be improved

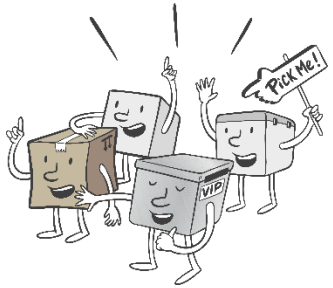
Digital Cold Chain Pioneers

Sustainable Sourcing

- Optimized Transportation and Logistics
- Energy Efficiency in Warehousing and Distribution Centers

Packaging Innovations

- Sustainable Packaging
- Lightweight Packaging



Digitalization and Technology Integration

- Supply Chain Transparency
- Predictive Analytics

Finding the right box for the right lane?

Lane Definition

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Define Lane: [Corona] FCO-AMS-DEL 50Szenario1

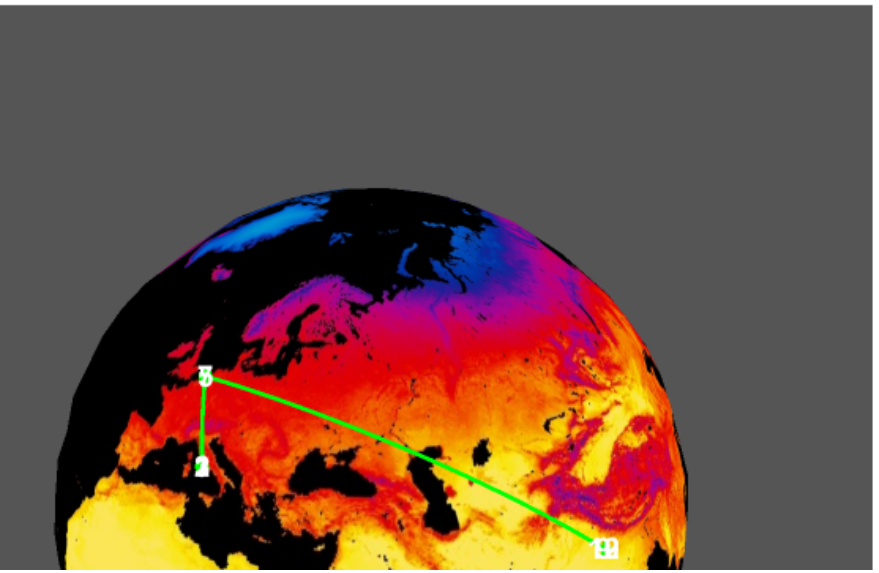
New | Open | Save | Save As | Import | Export | Historical Profiles | Profile Forecast | Solar Irra

Start-Time [UTC]: 00:20

	Name	δt/h	UTC	T/°C	Sun
1	Lead time acceptance area FCO	4.00	00:20		
2	Lead time build up area FCO	3.00	04:20		
3	Rome Tarmac	3.00	07:20		
4	Flight	2.50	10:20	15.0	
5	Amsterdam Airport Schiphol Tarmac	3.00	12:50		
6	Warehouse	19.00	15:50	20.0	
7	Amsterdam Airport Schiphol Tarmac	3.00	10:50		
8	Flight	9.00	13:50	15.0	
9	Lead time next to aircraft NewDelhi	1.00	22:50		
10	Lead time transport aircraft to warehouse NewDelhi	1.50	23:50		
11	Leadtime break down area NewDelhi	1.00	01:20	5.0	
12	Custom	10.00	02:20		
13	Truck	6.00	12:20	5.0	
	End	66.00	18:20		

Edit | Maps | Labels

Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec



FCO → AMS → DEL

Standard	10	2.5	25	9	19.5	66 h

Cost Panel

Packaging	Costs / $	Weight / kg
Packout-All-SeasonVIP	150.	17.334
Packout-SummerNew	55.	18.814
Packout-Summerlight	38.	13.019
Packout-All-SeasonVIPReuse	62.	34.4
Packout-All-SeasonPU	90.	14.09

→ Reverse Logistics

Costs for: Transport / $/kg	Excursion / $	Product loss / $
5.	6500	10 000.

Checks for excursions: (◉) Excursions ( ) Stability Data

Checks for failures: ( ) Excursions (◉) Stability Data

Shipments per ( ) Year (◉) Month

Jan	1000	Feb	416	Mar	417	Apr	417
May	417	Jun	416	Jul	417	Aug	700
Sep	800	Oct	417	Nov	590	Dec	417

Excursions are important!!

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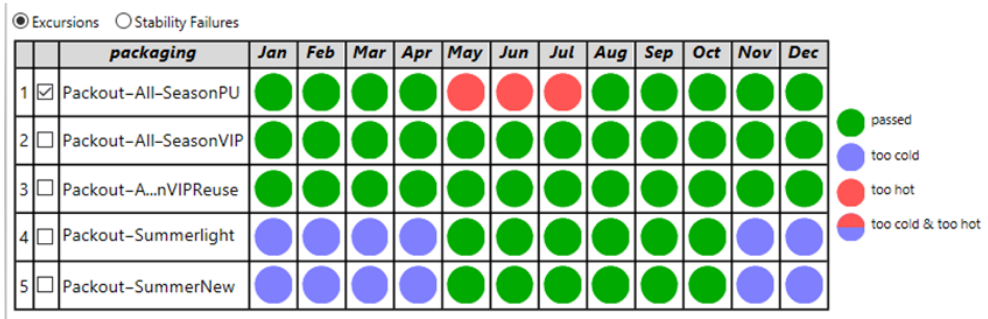
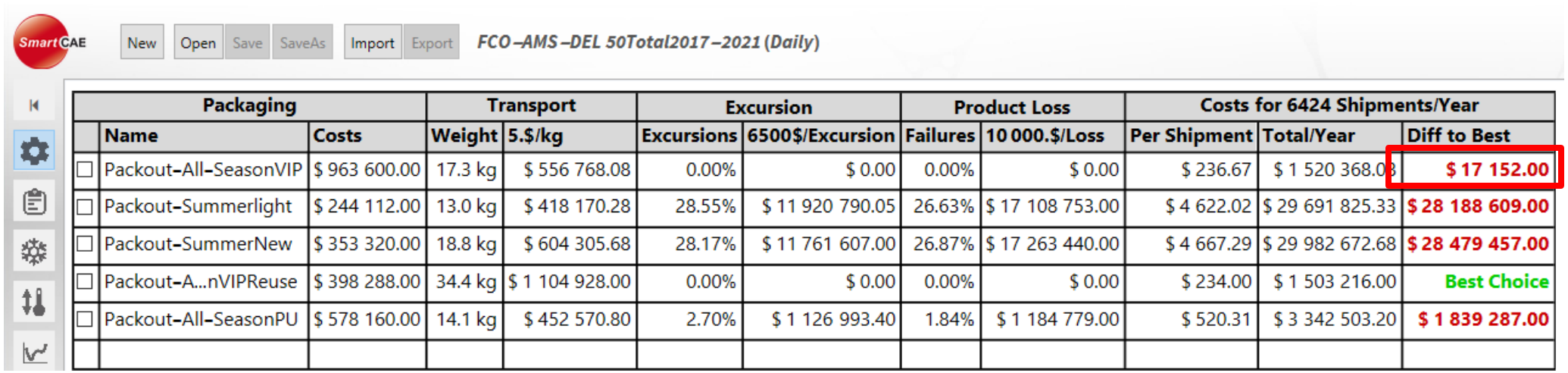
	packaging	#	no excursions	cold excursions	hot excursions	hot&cold excur.	stability checks
1	Packout-All-SeasonPU	1712	96.6%	0.0%	3.4%	0.0%	97.7%
2	Packout-All-SeasonVIP	1712	100.0%	0.0%	0.0%	0.0%	100.0%
3	Packout-A...nVIPReuse	1712	100.0%	0.0%	0.0%	0.0%	100.0%
4	Packout-Summerlight	1712	75.5%	24.5%	0.0%	0.0%	77.4%
5	Packout-SummerNew	1712	75.8%	24.2%	0.0%	0.0%	77.2%



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	1	1	1	1	1	1	1	1	1	1	1
	100.0%	100.0%	100.0%	100.0%	85.2%	74.5%	98.7%	100.0%	100.0%	100.0%	100.0%	100.0%
					14.8%	25.5%						
% pass	100.0	100.0	100.0	100.0	85.2	74.5	98.7	100.0	100.0	100.0	100.0	100.0
% cold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% hot	0.0	0.0	0.0	0.0	14.8	25.5	1.3	0.0	0.0	0.0	0.0	0.0
% both	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% fail	0.0	0.0	0.0	0.0	14.8	25.5	1.3	0.0	0.0	0.0	0.0	0.0
# profiles	140	129	148	141	135	145	153	146	133	150	141	151

Total costs for single solutions

Digital Cold Chain Pioneers



Packaging		Transport		Excursion		Product Loss		Costs for 6424 Shipments/Year		
Name	Costs	Weight	5.$/kg	Excursions	6500$/Excursion	Failures	10 000.$/Loss	Per Shipment	Total/Year	Diff to Best
Packout-All-SeasonVIP	$ 963 600.00	17.3 kg	$ 556 768.08	0.00%	$ 0.00	0.00%	$ 0.00	$ 236.67	$ 1 520 368.08	$ 17 152.00
Packout-Summerlight	$ 244 112.00	13.0 kg	$ 418 170.28	28.55%	$ 11 920 790.05	26.63%	$ 17 108 753.00	$ 4 622.02	$ 29 691 825.33	$ 28 188 609.00
Packout-SummerNew	$ 353 320.00	18.8 kg	$ 604 305.68	28.17%	$ 11 761 607.00	26.87%	$ 17 263 440.00	$ 4 667.29	$ 29 982 672.68	$ 28 479 457.00
Packout-A...nVIPReuse	$ 398 288.00	34.4 kg	$ 1 104 928.00	0.00%	$ 0.00	0.00%	$ 0.00	$ 234.00	$ 1 503 216.00	Best Choice
Packout-All-SeasonPU	$ 578 160.00	14.1 kg	$ 452 570.80	2.70%	$ 1 126 993.40	1.84%	$ 1 184 779.00	$ 520.31	$ 3 342 503.20	$ 1 839 287.00

Risk free savings of $17.000

Total costs for best combination–Single use

Digital Cold Chain Pioneers

New | Open | Save | SaveAs | Import | Export

FCO–AMS–DEL 50Total2017–2021 (Daily)

Packaging			Transport		Excursion		Product Loss		Costs for 6424 Shipments/Year		
	Name	Costs	Weight	5.$/kg	Excursions	6500$/Excursion	Failures	10 000.$/Loss	Per Shipment	Total/Year	Diff to Best
☑	Packout–All–SeasonVIP	$ 963 600.00	17.3 kg	$ 556 768.08	0.00%	$ 0.00	0.00%	$ 0.00	$ 236.67	$ 1 520 368.08	$ 671 281.00
☑	Packout–Summerlight	$ 244 112.00	13.0 kg	$ 418 170.28	28.55%	$ 11 920 790.05	26.63%	$ 17 108 753.00	$ 4 622.02	$ 29 691 825.33	$ 28 842 738.00
☑	Packout–SummerNew	$ 353 320.00	18.8 kg	$ 604 305.68	28.17%	$ 11 761 607.00	26.87%	$ 17 263 440.00	$ 4 667.29	$ 29 982 672.68	$ 29 133 585.00
☐	Packout–A...nVIPReuse	$ 398 288.00	34.4 kg	$ 1 104 928.00	0.00%	$ 0.00	0.00%	$ 0.00	$ 234.00	$ 1 503 216.00	$ 654 128.00
☑	Packout–All–SeasonPU	$ 578 160.00	14.1 kg	$ 452 570.80	2.70%	$ 1 126 993.40	1.84%	$ 1 184 779.00	$ 520.31	$ 3 342 503.20	$ 2 493 416.00
	Best Combination	$ 413 476.00	13.6 kg	$ 435 611.50	0.00%	$ 0.00	0.00%	$ 0.00	$ 132.17	$ 849 087.50	Best Choice

Chart | Table

Monthly Details

Month	#	Packaging	Packaging/$	Transport/$	Excursions/%	Excursions/$	Failures/%	Product Loss/$	Total/$
Jan	1000	Packout–All–SeasonPU	90 000.00	70 450.00	0.00	0.00	0.00	0.00	160 450.00
Feb	416	Packout–All–SeasonPU	37 440.00	29 307.20	0.00	0.00	0.00	0.00	66 747.20
Mar	417	Packout–All–SeasonPU	37 530.00	29 377.65	0.00	0.00	0.00	0.00	66 907.65
Apr	417	Packout–All–SeasonPU	37 530.00	29 377.65	0.00	0.00	0.00	0.00	66 907.65
May	417	Packout–Summerlight	15 846.00	27 144.61	0.00	0.00	0.00	0.00	42 990.61
Jun	416	Packout–Summerlight	15 808.00	27 079.52	0.00	0.00	0.00	0.00	42 887.52
Jul	417	Packout–Summerlight	15 846.00	27 144.61	0.00	0.00	0.00	0.00	42 990.61
Aug	700	Packout–Summerlight	26 600.00	45 566.50	0.00	0.00	0.00	0.00	72 166.50
Sep	800	Packout–Summerlight	30 400.00	52 076.00	0.00	0.00	0.00	0.00	82 476.00
Oct	417	Packout–Summerlight	15 846.00	27 144.61	0.00	0.00	0.00	0.00	42 990.61
Nov	590	Packout–All–SeasonPU	53 100.00	41 565.50	0.00	0.00	0.00	0.00	94 665.50
Dec	417	Packout–All–SeasonPU	37 530.00	29 377.65	0.00	0.00	0.00	0.00	66 907.65
Total	6424		413 476.00	435 611.50		0.00		0.00	849 087.50

Risk free savings of $671.000

Digital Cold Chain Pioneers

A closer look on the CO2 footprint and costs again

Flight lane

Digital Cold Chain Pioneers

Define Lane: [Corona] FCO-AMS-DEL 50Szenario1

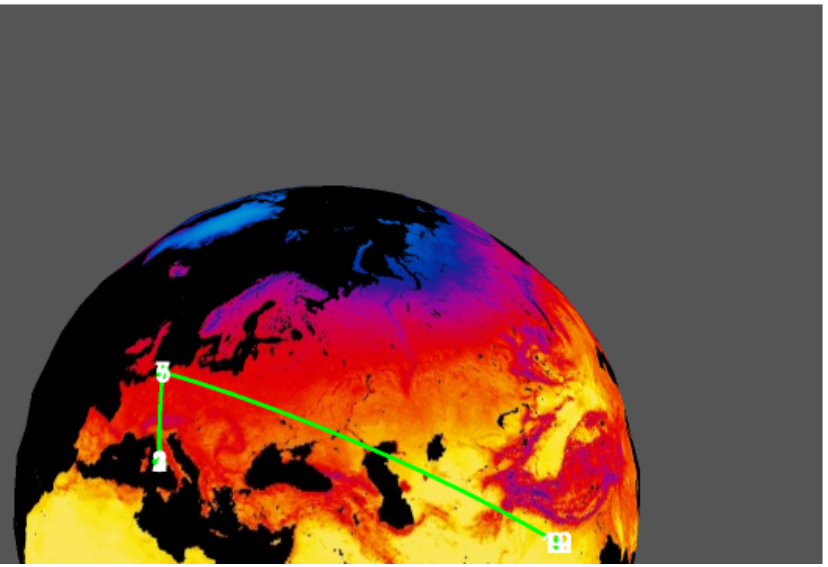
New | Open | Save | Save As | Import | Export | Historical Profiles | Profile Forecast | Solar Irra

Start-Time [UTC]: 00:20

	Name	δt/h	UTC	T/°C	Sun
1	Lead time acceptance area FCO	4.00	00:20		
2	Lead time build up area FCO	3.00	04:20		
3	Rome Tarmac	3.00	07:20		
4	Flight	2.50	10:20	15.0	
5	Amsterdam Airport Schiphol Tarmac	3.00	12:50		
6	Warehouse	19.00	15:50	20.0	
7	Amsterdam Airport Schiphol Tarmac	3.00	10:50		
8	Flight	9.00	13:50	15.0	
9	Lead time next to aircraft NewDelhi	1.00	22:50		
10	Lead time transport aircraft to warehouse NewDelhi	1.50	23:50		
11	Leadtime break down area NewDelhi	1.00	01:20	5.0	
12	Custom	10.00	02:20		
13	Truck	6.00	12:20	5.0	
	End	66.00	18:20		

Edit | Maps | Labels

Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec

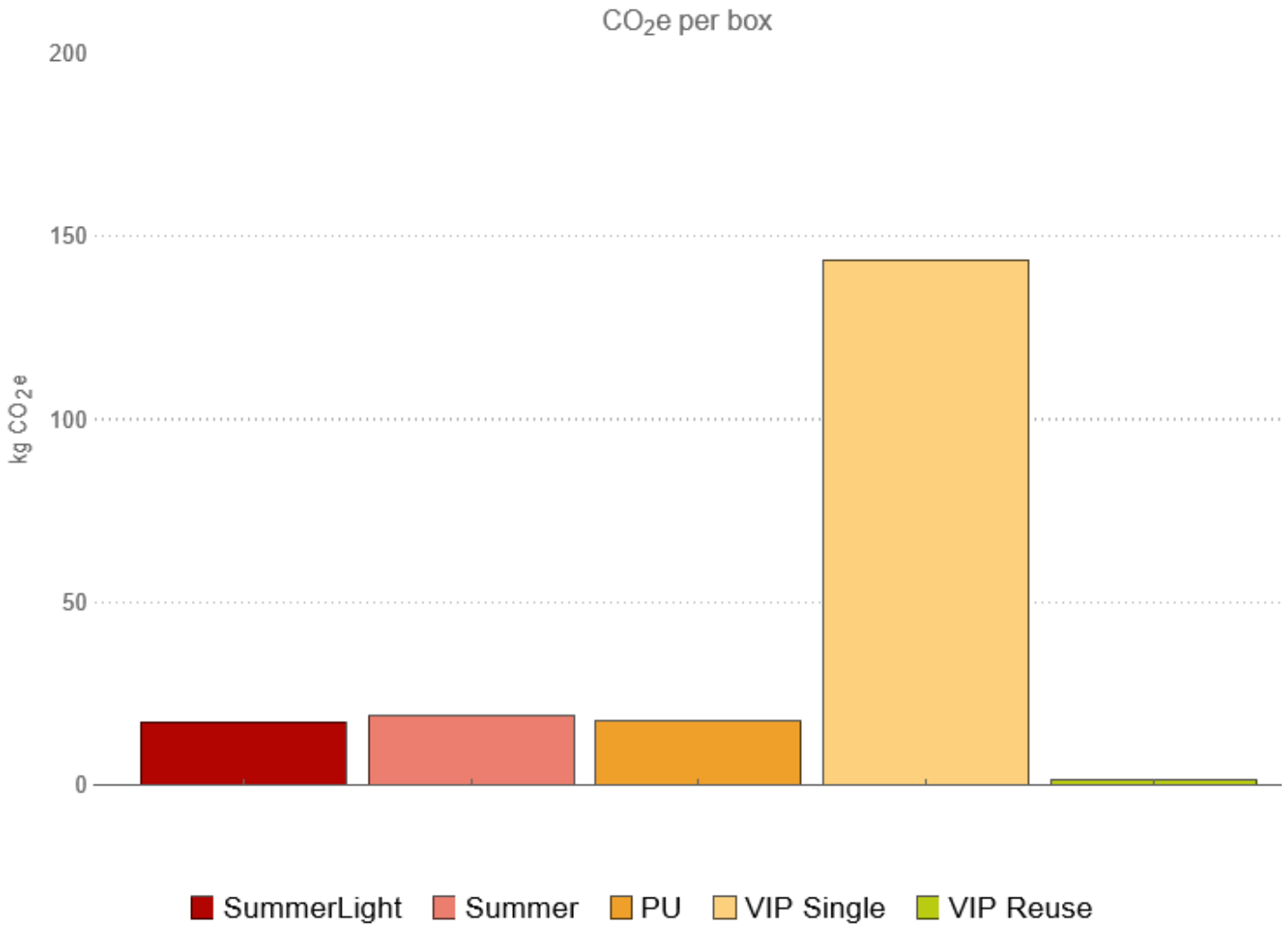


FCO → AMS → DEL

Standard	10	2.5	25	9	19.5	66 h

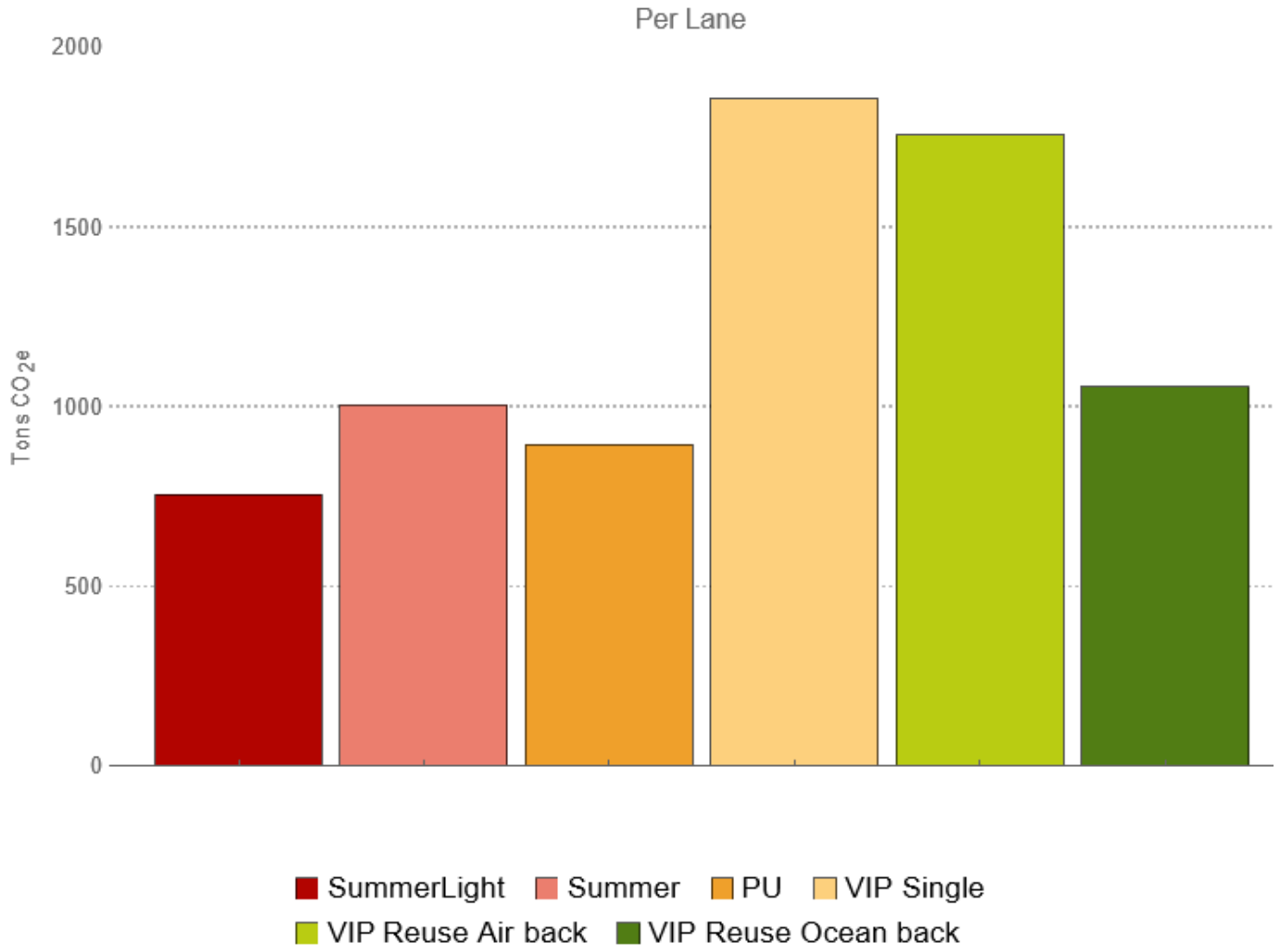
CO2 Fingerprint per used boxes

Digital Cold Chain Pioneers

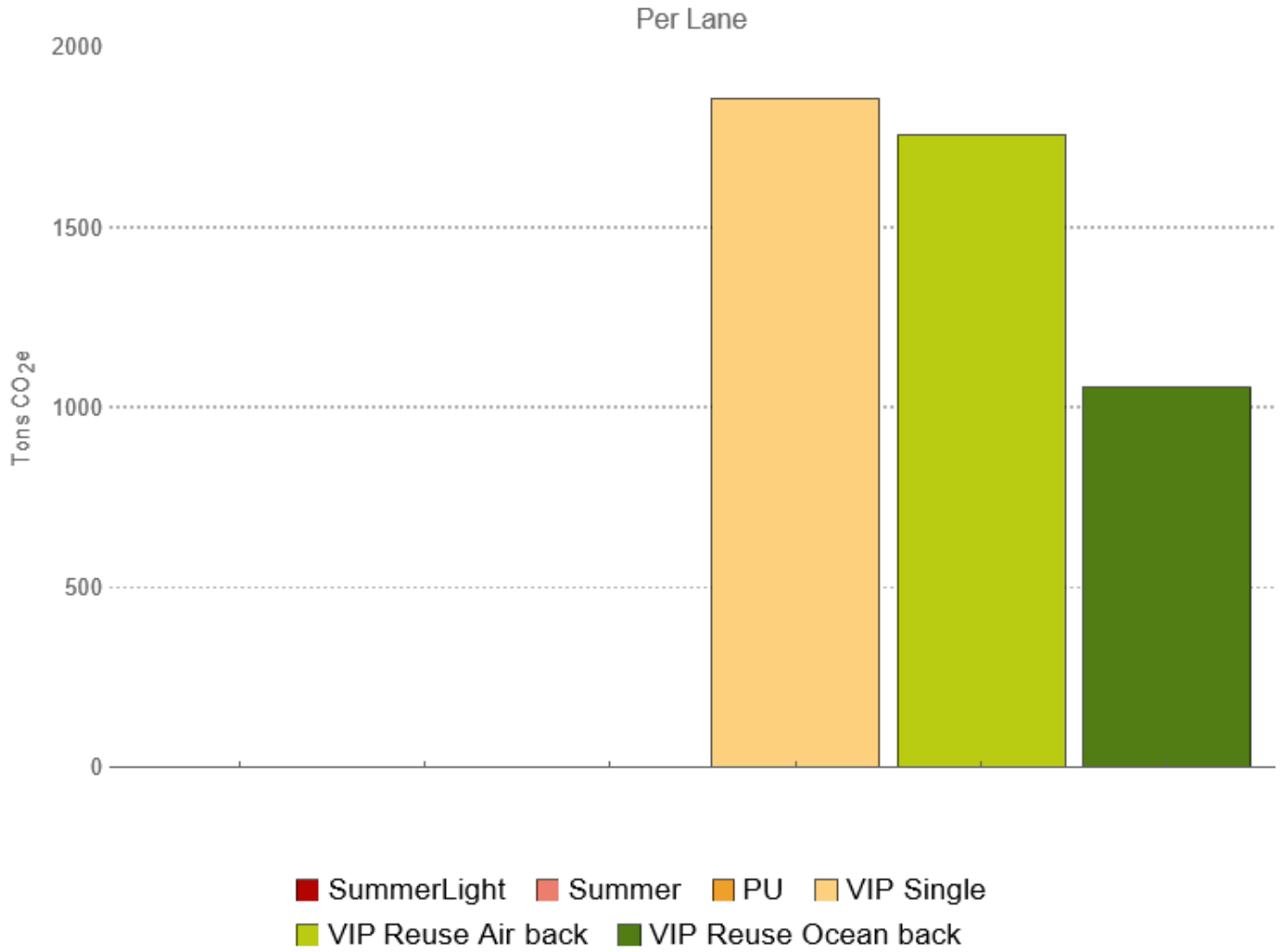


100 times reused

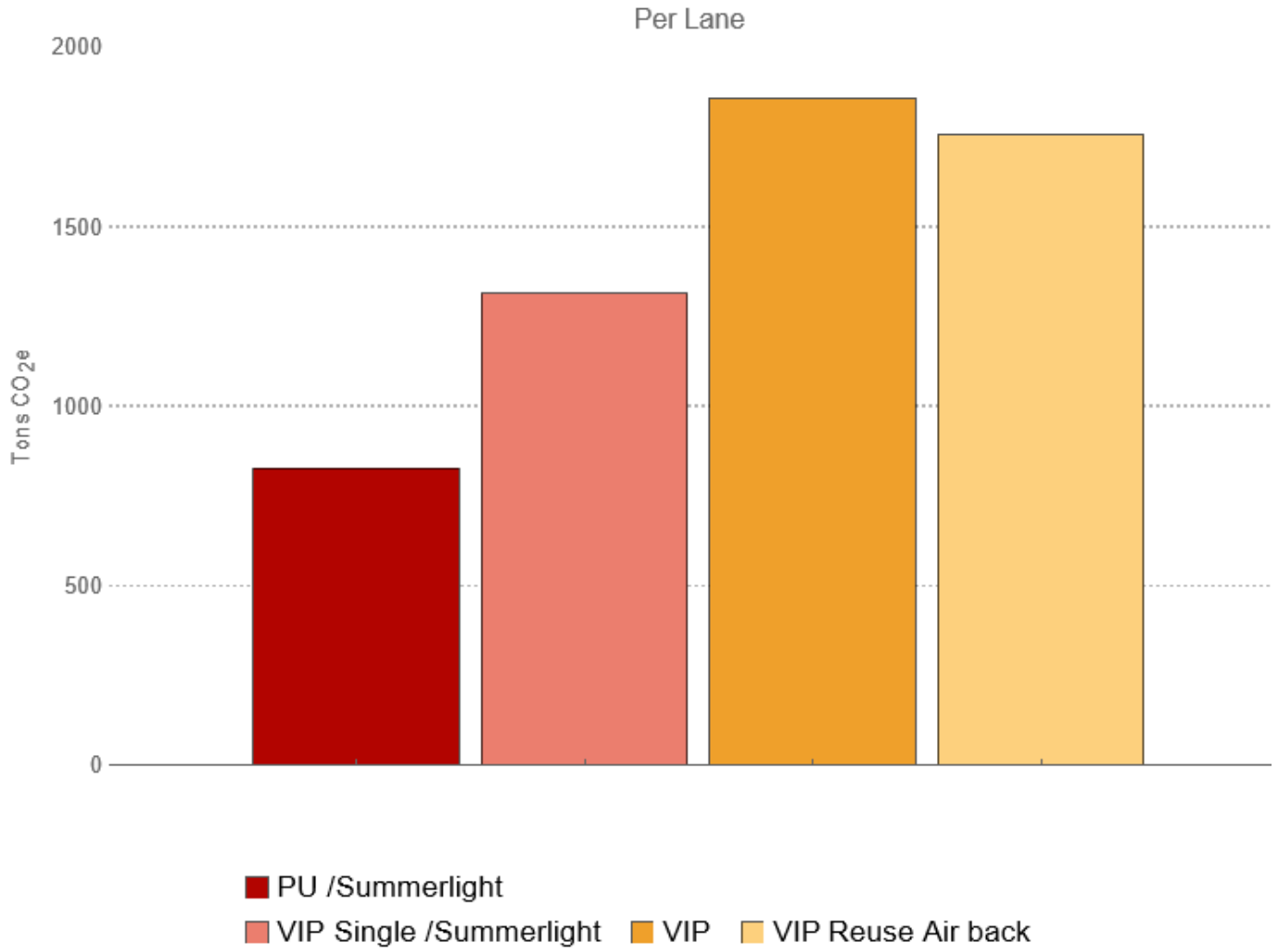
CO2 Fingerprint per lane all boxes



CO2 Fingerprint per lane only compliant boxes

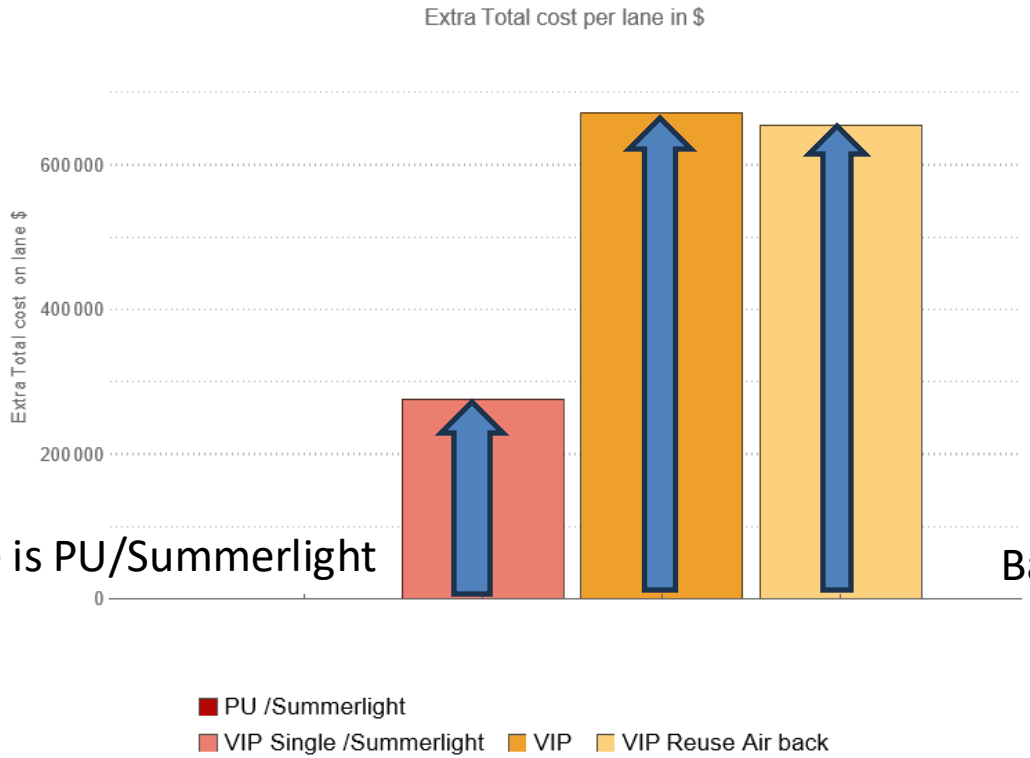


CO2 Fingerprint per lane only compliant and cost effective combinations of boxes

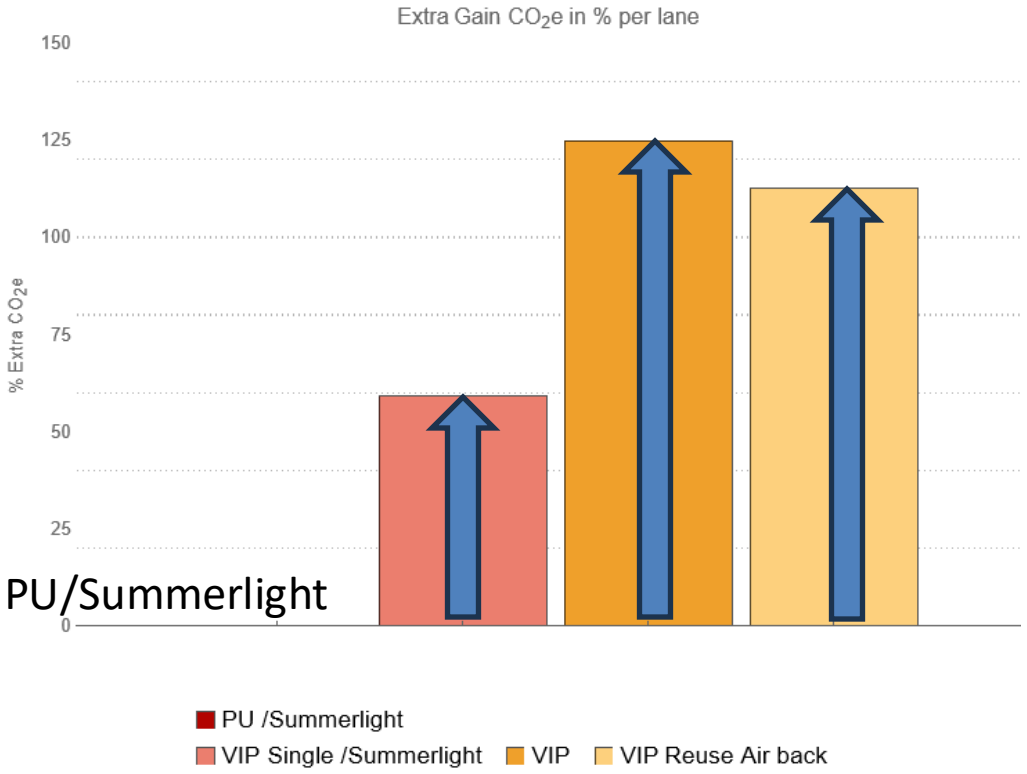


Cost and CO2 gain

Digital Cold Chain Pioneers



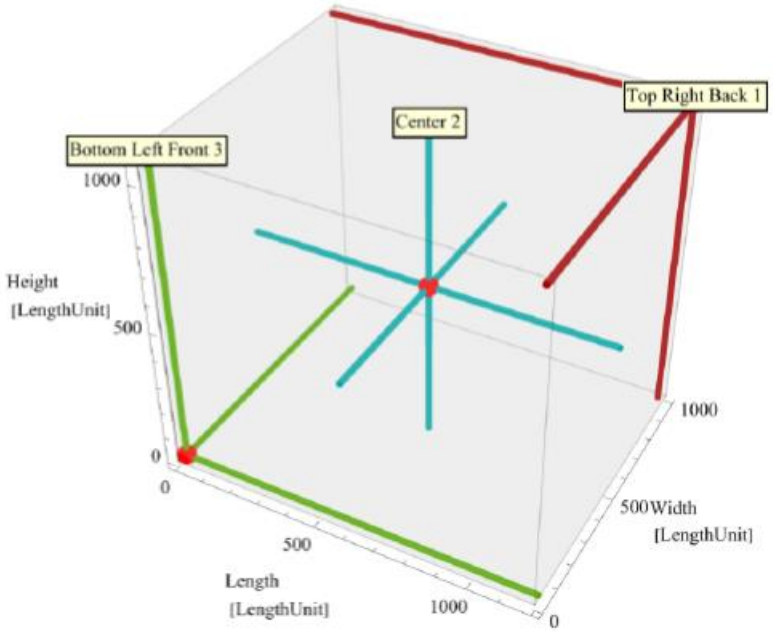
Baseline is PU/Summerlight



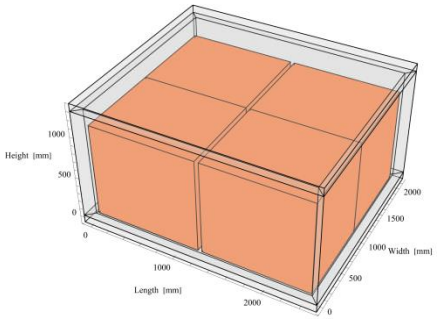
Baseline is PU/Summerlight

How different service levels/Routings impact the shipment?

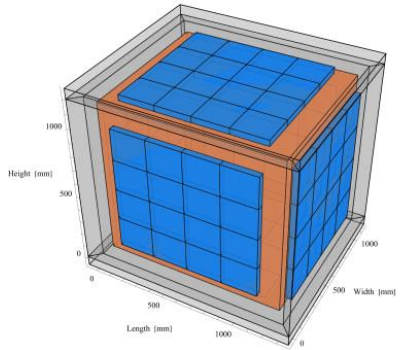
Digital Twin of the Shipper



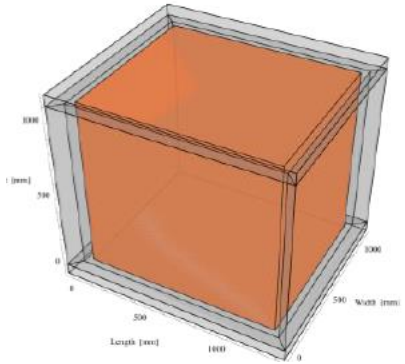
- Standard US Pallet
- Payload: Water based product
- Product: 2° to 8°C
- 3 sensors in the payload
- No stability assumed



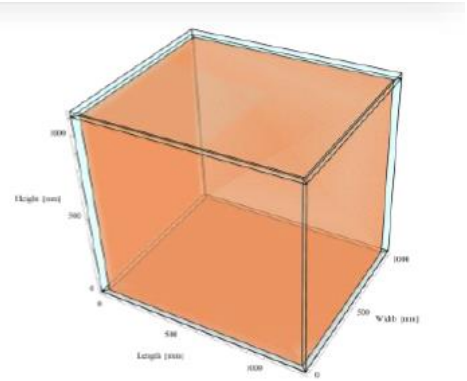
Active RAP



PU shipper



PU lite



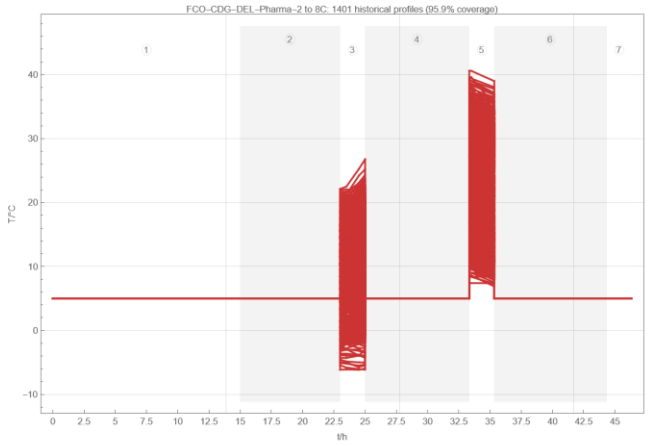
Blanket

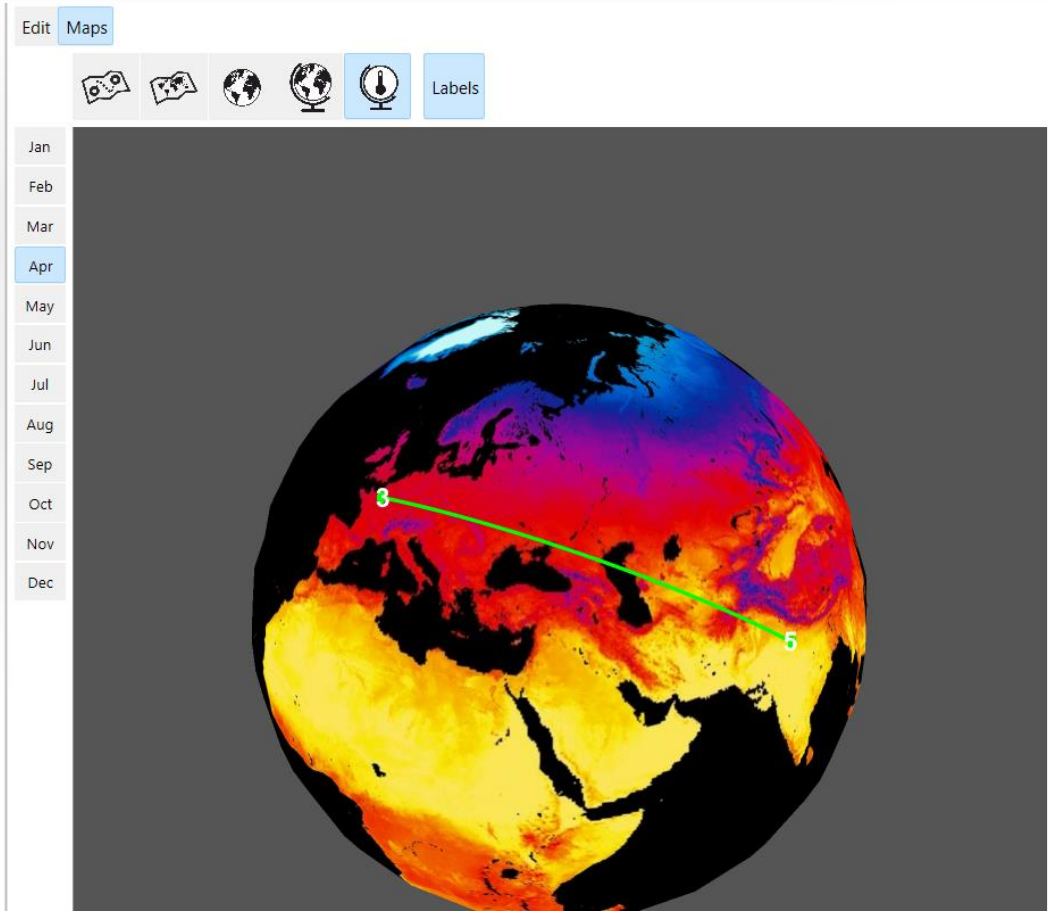
Lane: FCO – CDG – DEL with service level of 2 to 8 ° C

Digital Cold Chain Pioneers

Start-Time [UTC]: 06:00

	Name	δt / h	UTC	T/°C	Sun
1	Pickup Rome–Truck	15.00	06:00	5.0	
2	Warehouse–CDG	8.00	21:00	5.0	
3	Loading CDG – Tarmac	2.00	05:00		✓
4	Flight – CDG to Delhi	8.34	07:00	5.0	
5	Unloading Delhi – Tarmac	2.00	15:20		✓
6	Warehouse Delhi	9.00	17:20	5.0	
7	Delivery Delhi–Truck	2.00	02:20	5.0	
	End	46.34	04:20		



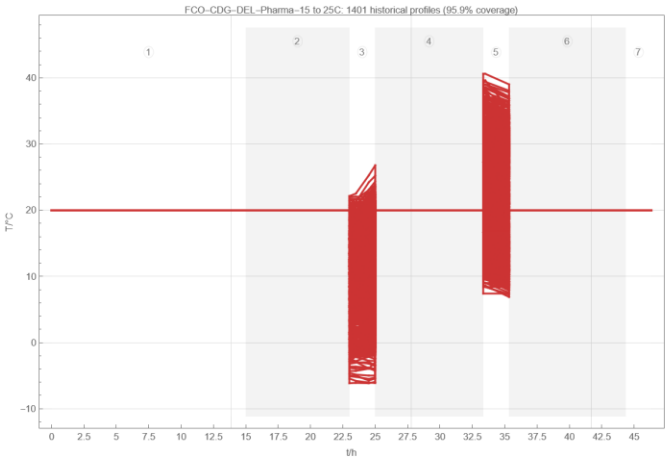


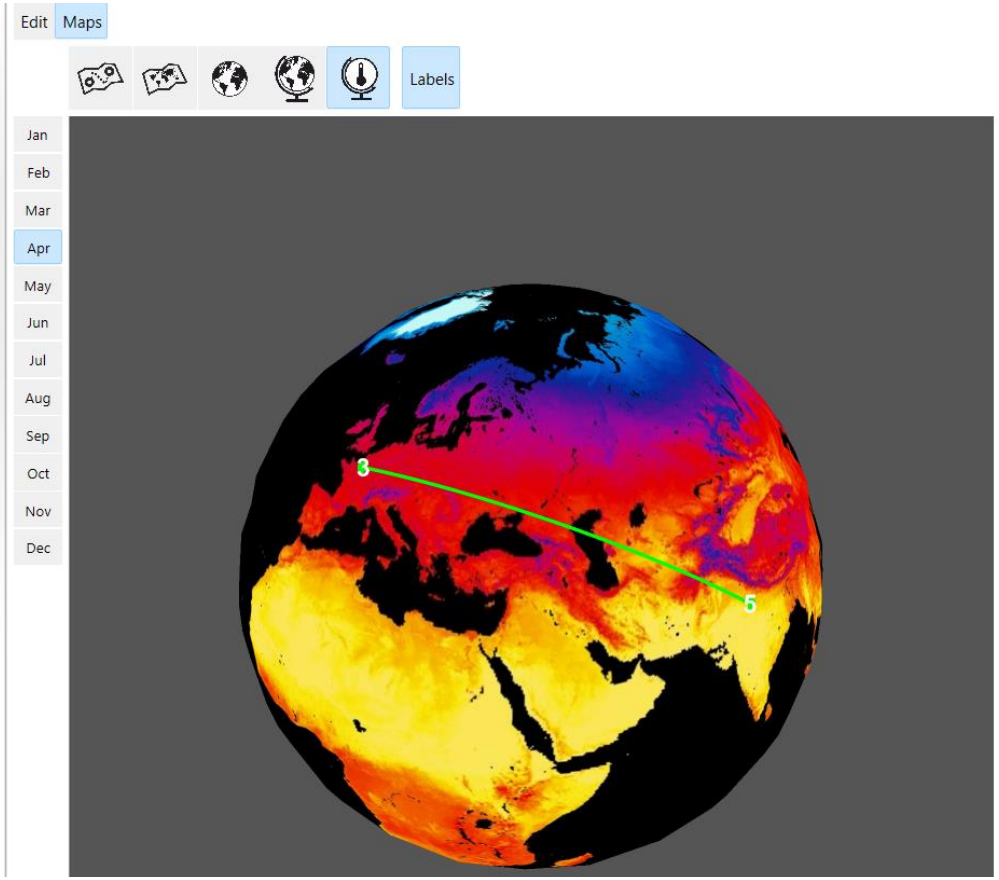
Lane: FCO – CDG – DEL with service level of 15 to 25 ° C

Digital Cold Chain Pioneers

Start-Time [UTC]: 06:00

	Name	δt/h	UTC	T/°C	Sun
1	Pickup Rome-Truck	15.00	06:00	20.0	
2	Warehouse-CDG	8.00	21:00	20.0	
3	Loading CDG – Tarmac	2.00	05:00		✓
4	Flight – CDG to Delhi	8.34	07:00	20.0	
5	Unloading Delhi – Tarmac	2.00	15:20		✓
6	Warehouse Delhi	9.00	17:20	20.0	
7	Delivery Delhi-Truck	2.00	02:20	20.0	
	End	46.34	04:20		





FCO — CDG — DEL

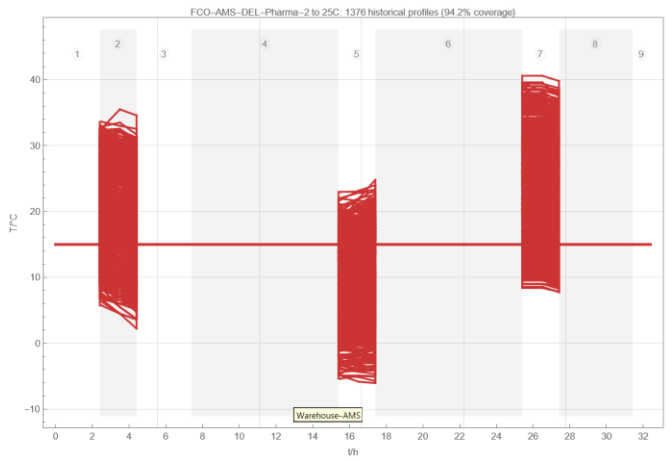
Standard	15	10	8	13	46 h

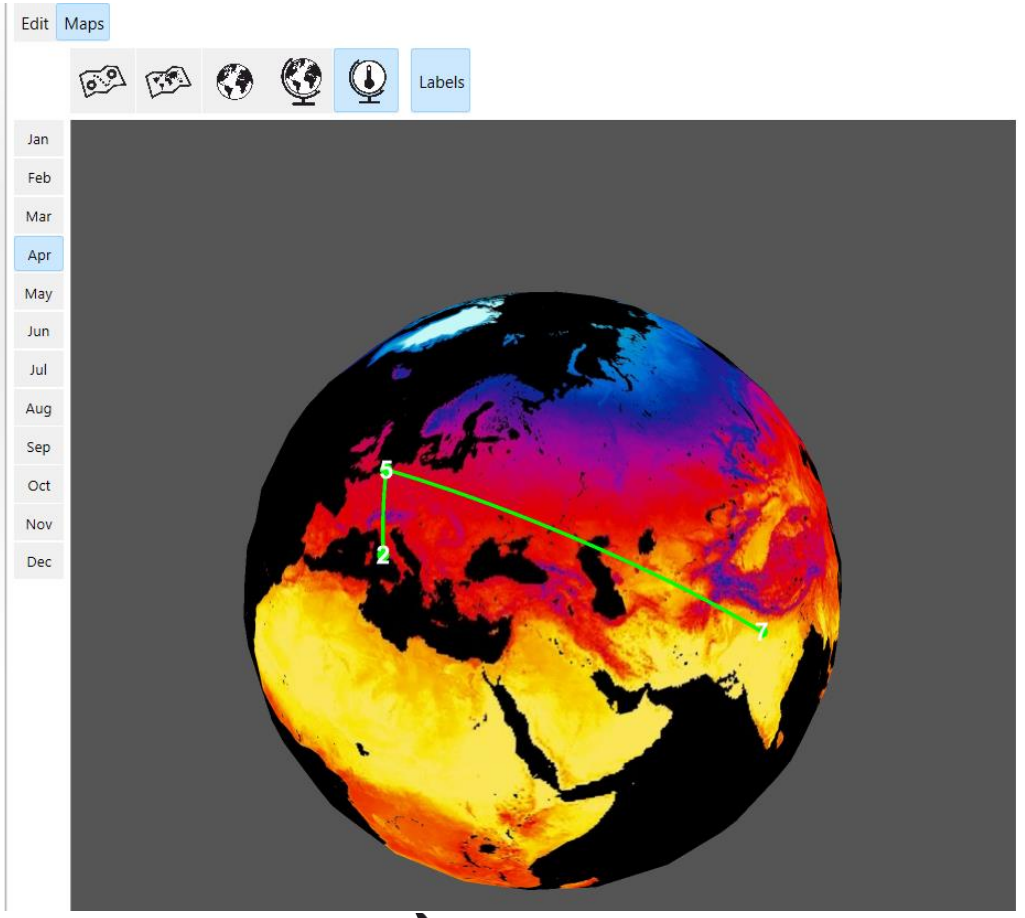
Lane: FCO – CDG – DEL with service level of 2 to 25 ° C

Digital Cold Chain Pioneers

Start-Time [UTC]: 13:00

	Name	δt / h	UTC	T/°C	Sun
1	Pickup FCO–Truck	2.41	13:00	15.0	
2	Loading FCO–Tarmac	2.00	15:25		
3	Flight FCO to AMS	3.00	17:25	15.0	
4	Warehouse–AMS	8.00	20:25	15.0	
5	Loading AMS – Tarmac	2.00	04:25		✓
6	Flight – AMS to Delhi	8.00	06:25	15.0	
7	Unloading Delhi – Tarmac	2.00	14:25		✓
8	Warehouse Delhi	4.00	16:25	15.0	
9	Delivery Delhi–Truck	1.00	20:25	15.0	
		End	32.41	21:25	





FCO ✈ AMS ✈ DEL

Standard	5	10	8	7	32 h

Excursion Summary for 2 to 8 ° C service level

	packaging	#	no excursions	cold excursions	hot excursions	hot&cold excur.
1	Active RAP	1401	100.0%	0.0%	0.0%	0.0%
2	Advanced PU	1401	100.0%	0.0%	0.0%	0.0%
3	Blanket	1401	3.2%	1.1%	93.4%	2.3%
4	PU lite	1401	42.8%	0.0%	57.2%	0.0%

	packaging	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Active RAP												
2	Advanced PU												
3	Blanket												
4	PU lite												

Excursion Summary for 15 to 25 ° C service level

	packaging	#	no excursions	cold excursions	hot excursions	hot&cold excur.
1	Active RAP	1401	100.0%	0.0%	0.0%	0.0%
2	Advanced PU	1401	100.0%	0.0%	0.0%	0.0%
3	Blanket	1401	0.0%	0.0%	100.0%	0.0%
4	PU lite	1401	0.0%	0.0%	100.0%	0.0%

	packaging	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Active RAP	●	●	●	●	●	●	●	●	●	●	●	●
2	Advanced PU	●	●	●	●	●	●	●	●	●	●	●	●
3	Blanket	●	●	●	●	●	●	●	●	●	●	●	●
4	PU lite	●	●	●	●	●	●	●	●	●	●	●	●

Excursion Summary for 2 to 25 ° C service level

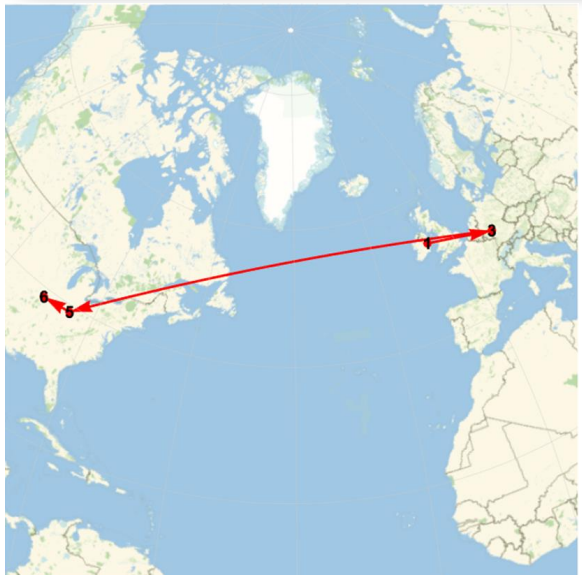
	packaging	#	no excursions	cold excursions	hot excursions	hot&cold excur.
1	Active RAP	1376	100.0%	0.0%	0.0%	0.0%
2	Advanced PU	1376	100.0%	0.0%	0.0%	0.0%
3	Blanket	1376	0.0%	0.0%	100.0%	0.0%
4	PU lite	1376	0.0%	0.0%	100.0%	0.0%

	packaging	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Active RAP	●	●	●	●	●	●	●	●	●	●	●	●
2	Advanced PU	●	●	●	●	●	●	●	●	●	●	●	●
3	Blanket	●	●	●	●	●	●	●	●	●	●	●	●
4	PU lite	●	●	●	●	●	●	●	●	●	●	●	●

- passed
- too cold
- too hot
- too cold & too hot

Difference between Mock-Up and Digital Lane Risk

Mock Up Shipment on One Specific Date: July 7 2023



Start–Time [UTC]: 09:30

	Name	δt / h	UTC	T/℃	Sun
1	Dublin	10.00	09:30		✓
2	Air Transport from Dublin to Frankfurt	2.00	19:30	12.0	
3	Transit at Frankfurt airport	10.00	21:30		✓
4	Flight Frankfurt to Cincinnati	12.00	07:30	12.0	
5	Transit at Cincinnati airport	24.00	19:30		✓
6	Ground Transport to St. Louis	10.00	19:30		✓
	End	68.00	05:30		

A mock-up shipment is done on one specific day.

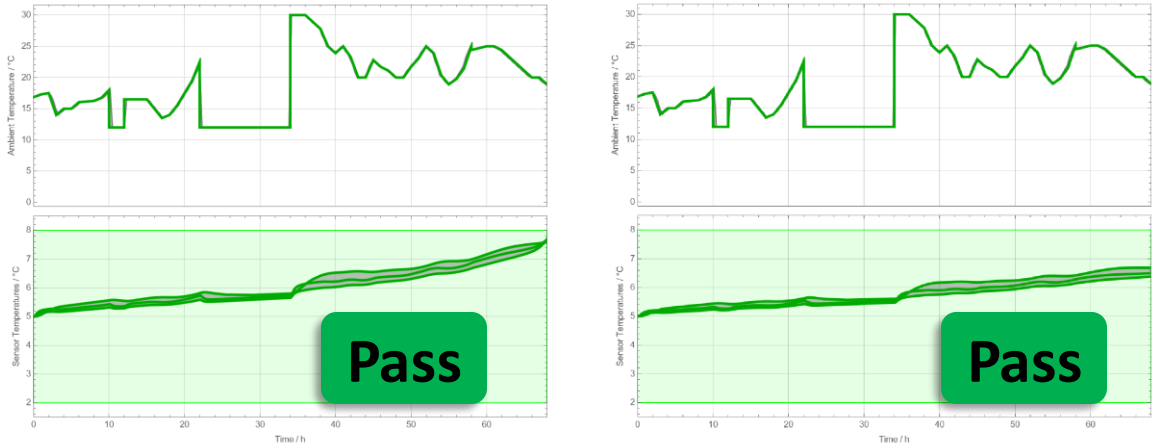
→ This particular day went OK.

→ **But what is its statistical value?**

Box 1 **Box 2**

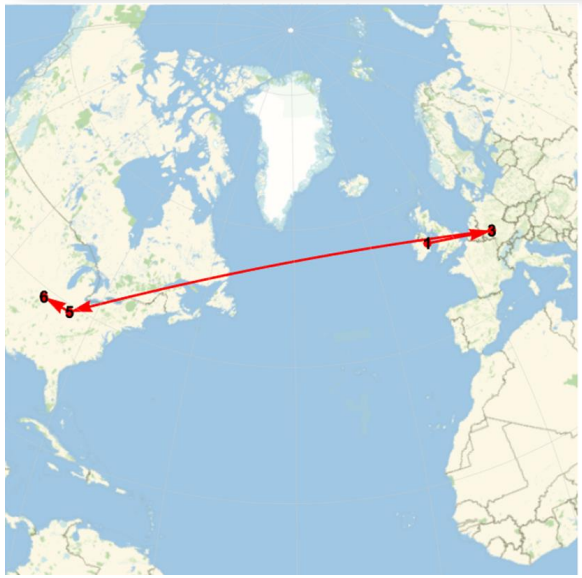
Ambient temperature

Product temperature



Digital Lane Risk with 2016-2023 Data July

Digital Cold Chain Pioneers



Start–Time [UTC]: 09:30

	Name	δt / h	UTC	T/℃	Sun
1	Dublin	10.00	09:30		✓
2	Air Transport from Dublin to Frankfurt	2.00	19:30	12.0	
3	Transit at Frankfurt airport	10.00	21:30		✓
4	Flight Frankfurt to Cincinnati	12.00	07:30	12.0	
5	Transit at Cincinnati airport	24.00	19:30		✓
6	Ground Transport to St. Louis	10.00	19:30		✓
	End	68.00	05:30		

A digital Lane Risk allows you to play **all scenarios:**

- Different Boxes
- Delays like Customs
- Temperature Ranges
- Stability Data

Mock up passes, but statistically most of the shipments fail

	#	no excursions	cold excursions	hot excursions	hot&cold excur.
Box 1	119	4.2%	0.0%	95.8%	0.0%
Box 2	119	100.0%	0.0%	0.0%	0.0%

In this case, the mockup day was just an lucky pick!

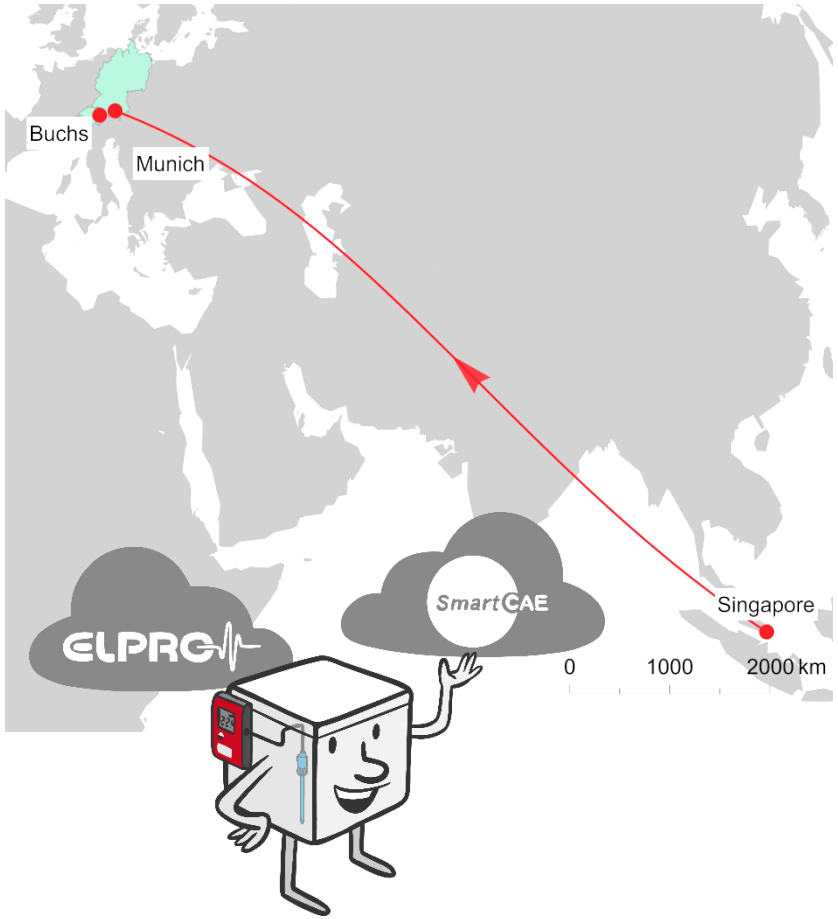
Actual shipment vs real shipment

A real-life story: Singapore to Switzerland

updated

Digital Cold Chain Pioneers

Scenario 1: Singapore – Munich - Buchs



Live tracking with Elpro real-time device:

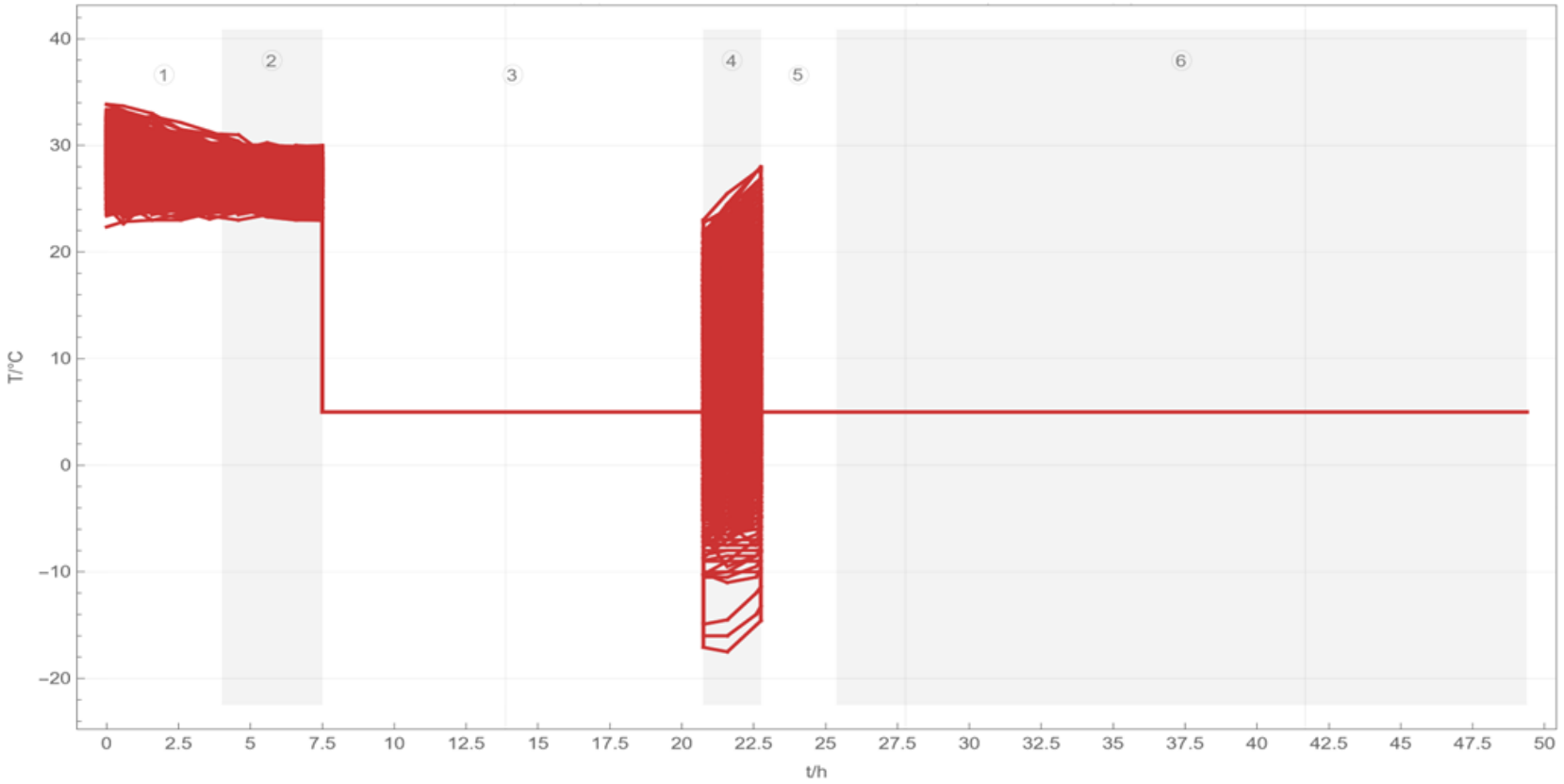
- Ambient temperature is recorded
- Live location is recorded
- The actual route travelled by the shipper is obtained

Tasks:

- How much it varies from the planned route?
- What is the cost and carbon footprint for the two routes?
- What would have been the carbon footprint saving by a better base planning?

Historical temperature profiles for the planned lane

Singapore – Munich – Buchs

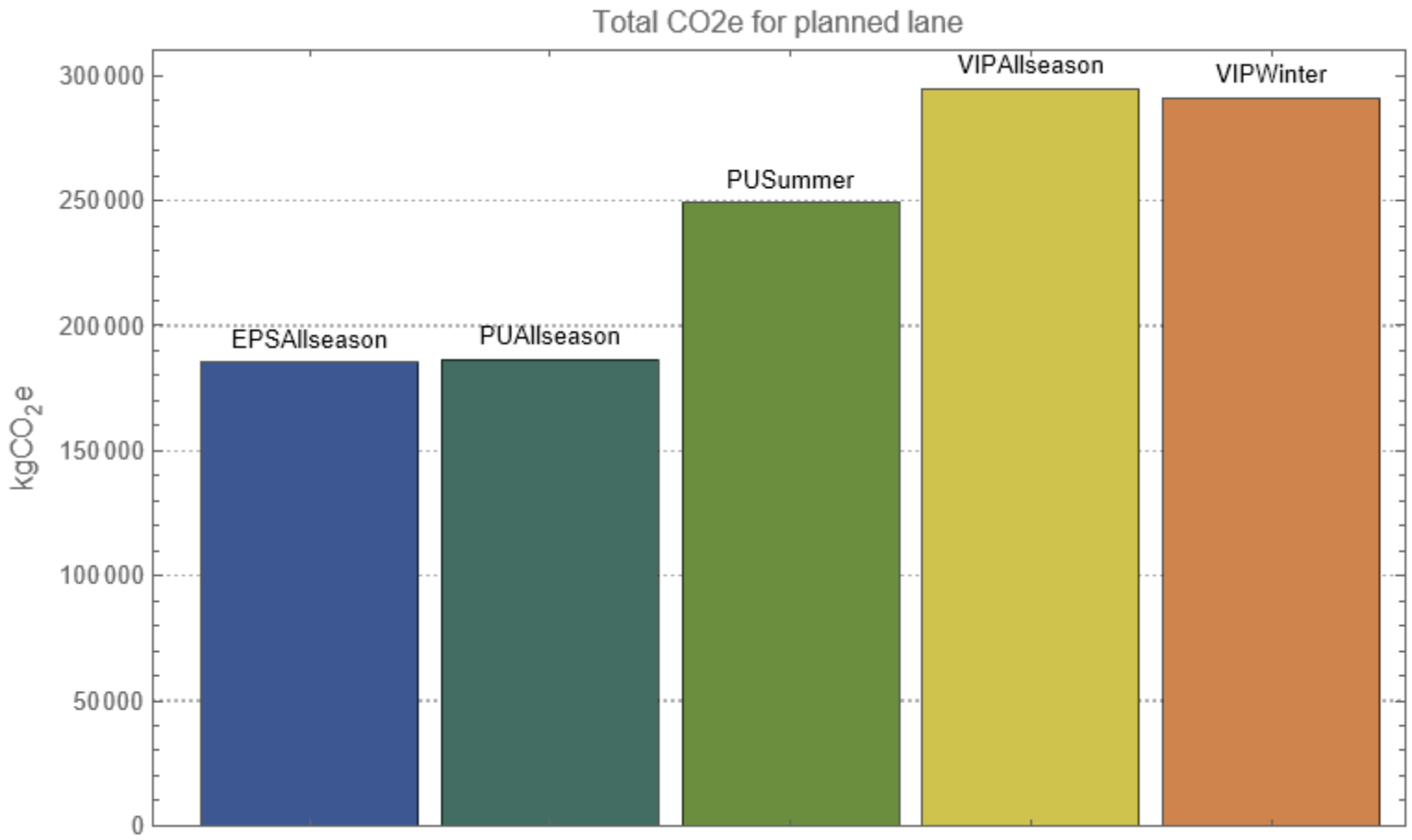


Overview of box performance for planned lane

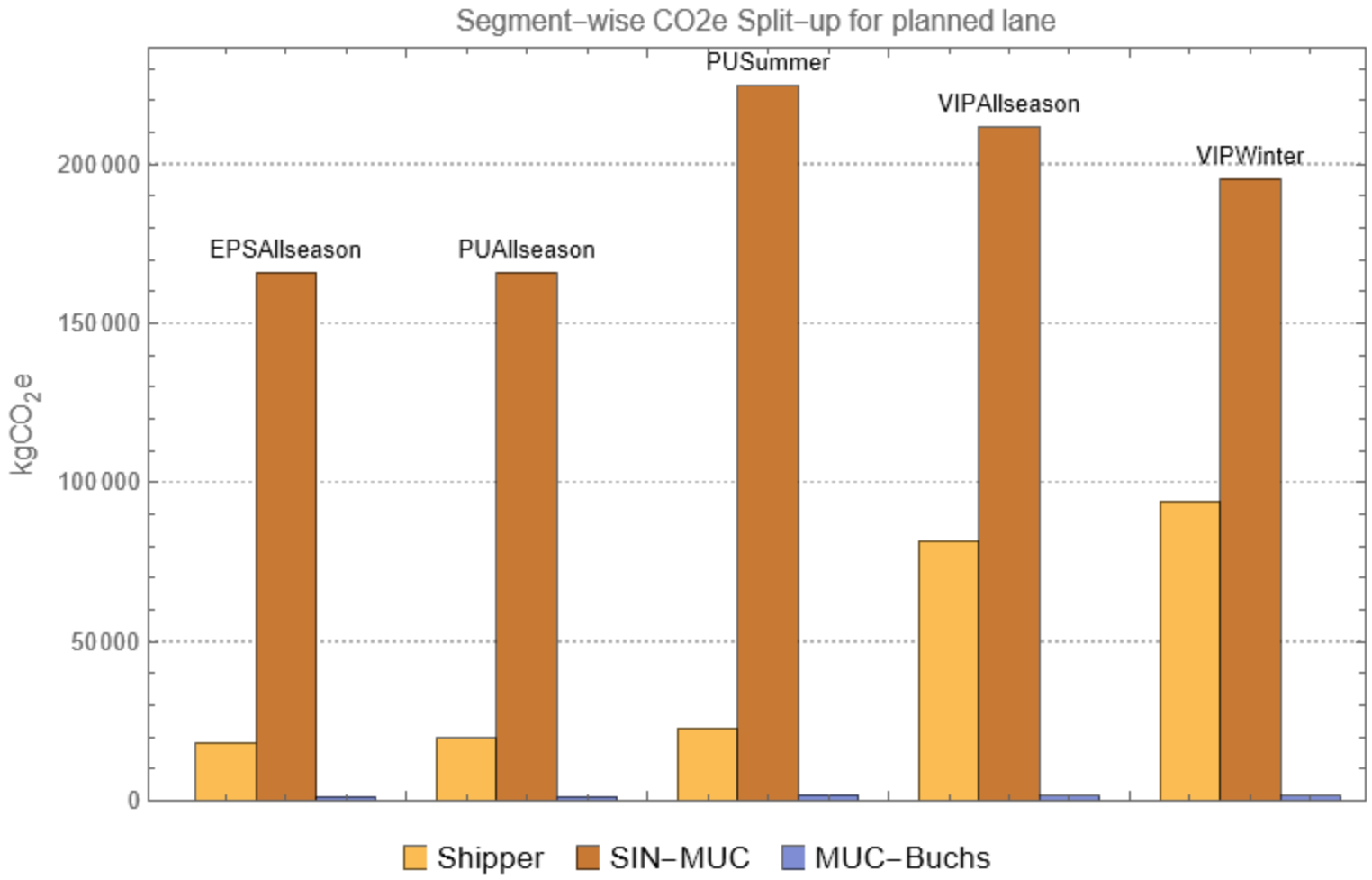
	packaging	#	no excursions	cold excursions	hot excursions	hot&cold excur.
1	EPS all-season	1786	100.0%	0.0%	0.0%	0.0%
2	PU all-season	1786	100.0%	0.0%	0.0%	0.0%
3	PU summer	1786	0.0%	100.0%	0.0%	0.0%
4	VIP all-season	1786	100.0%	0.0%	0.0%	0.0%
5	VIP winter	1786	100.0%	0.0%	0.0%	0.0%

		packaging	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	☐	EPS all-season	●	●	●	●	●	●	●	●	●	●	●	●
2	☐	PU all-season	●	●	●	●	●	●	●	●	●	●	●	●
3	☐	PU summer	●	●	●	●	●	●	●	●	●	●	●	●
4	☐	VIP all-season	●	●	●	●	●	●	●	●	●	●	●	●
5	☐	VIP winter	●	●	●	●	●	●	●	●	●	●	●	●

Carbon footprint comparison – planned lane



Segment-wise CO2 split up

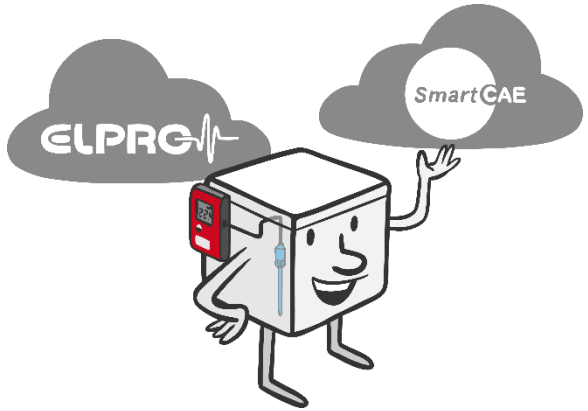


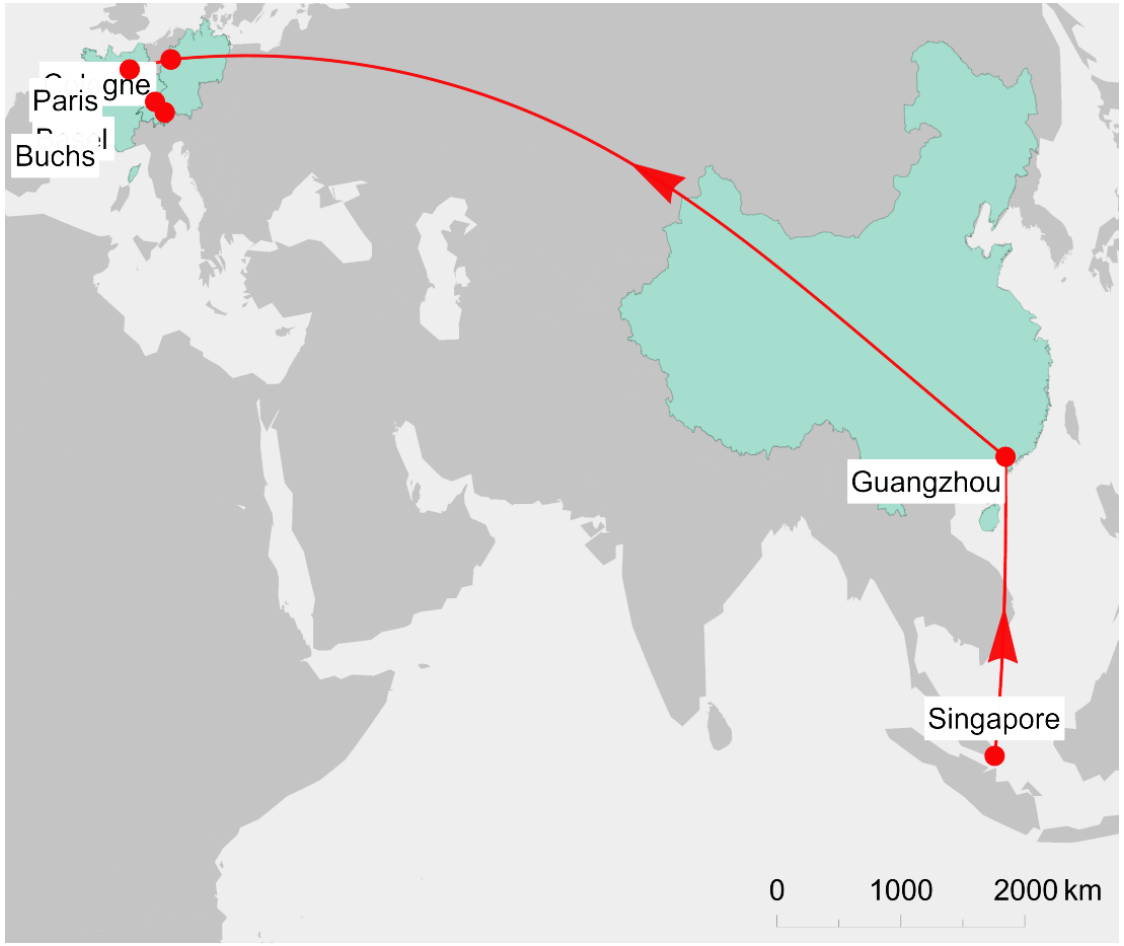
A real-life story: Singapore to Switzerland

updated

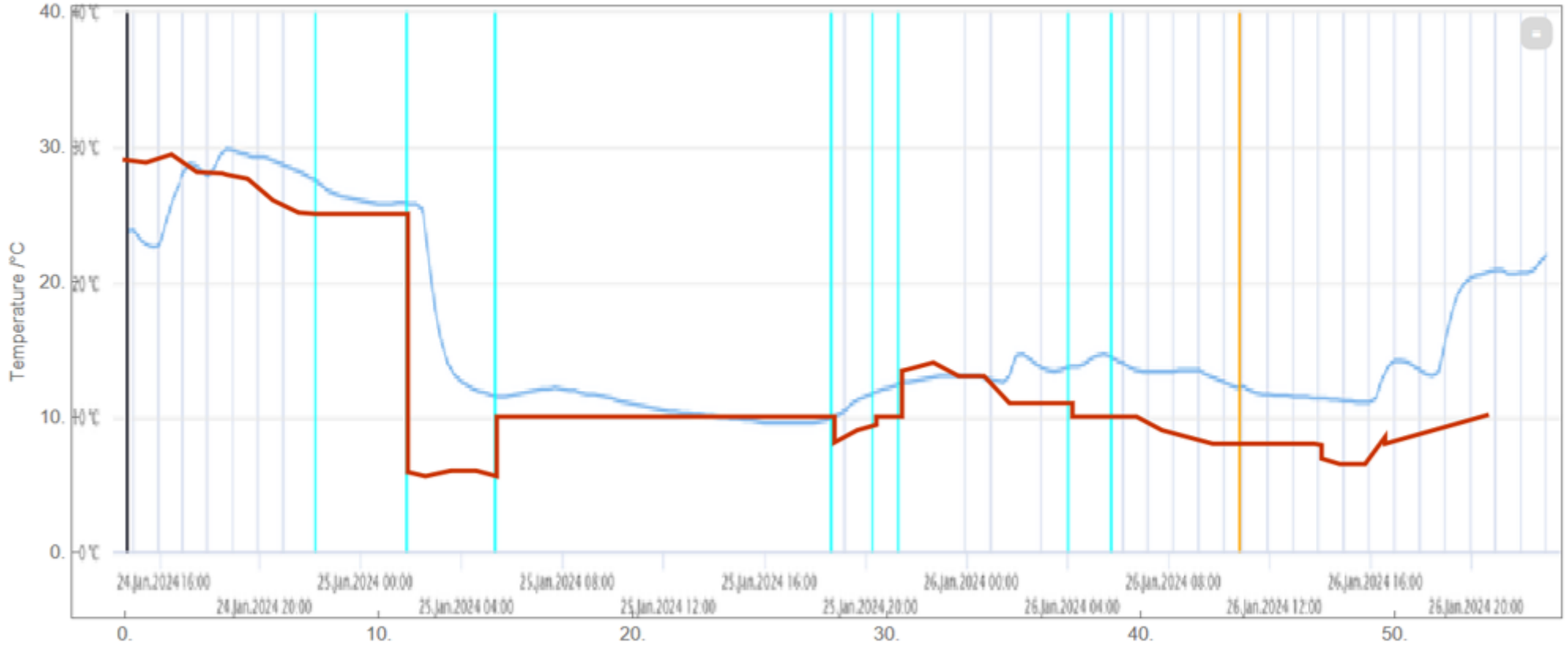
Digital Cold Chain Pioneers

Scenario 2: Singapore – Guangzhou – Cologne – Paris – Basel – Buchs



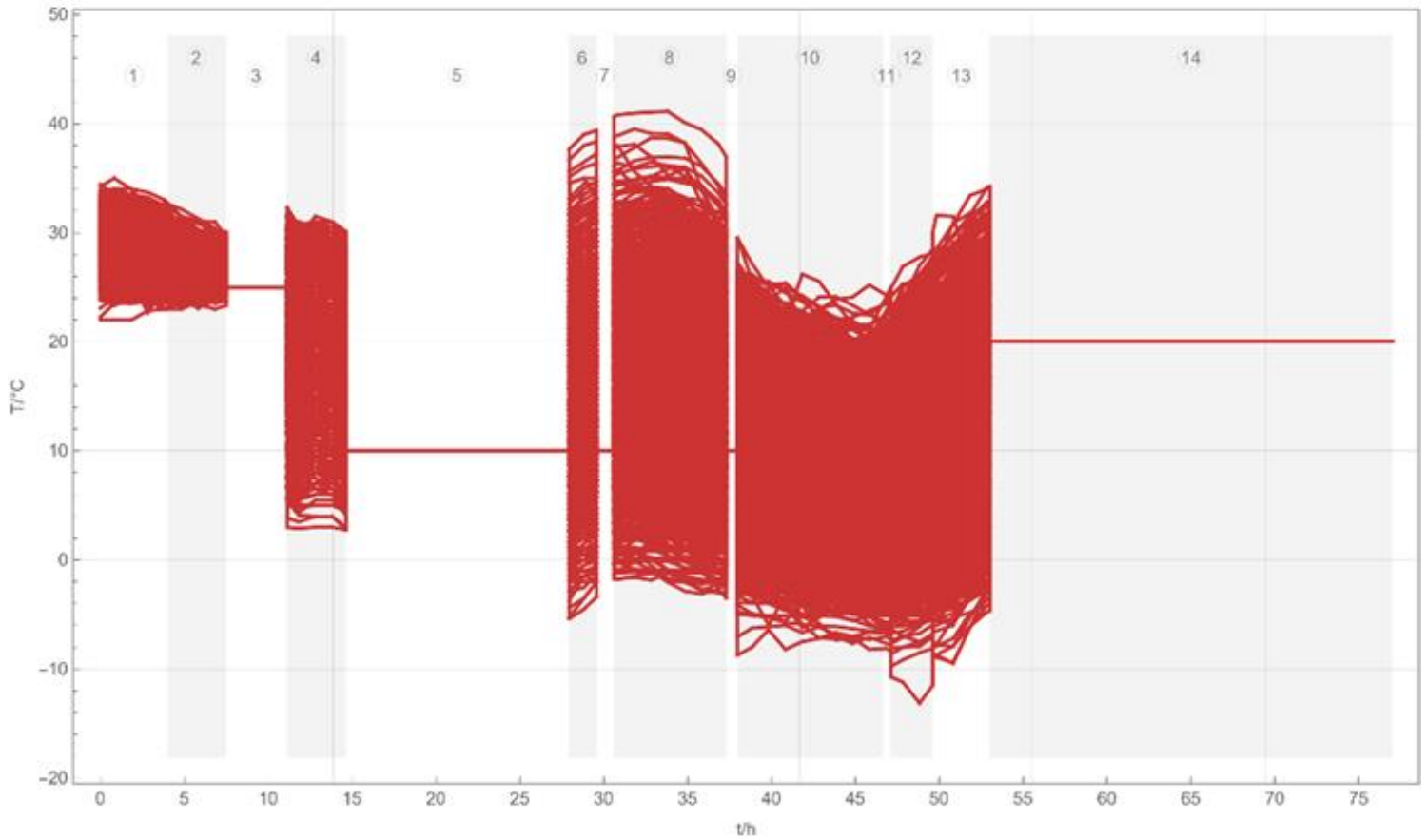


Add weather data comparison with live-tracking



Actual lane with real-time monitoring

Singapore – Guangzhou – Cologne – Paris – Basel Buchs



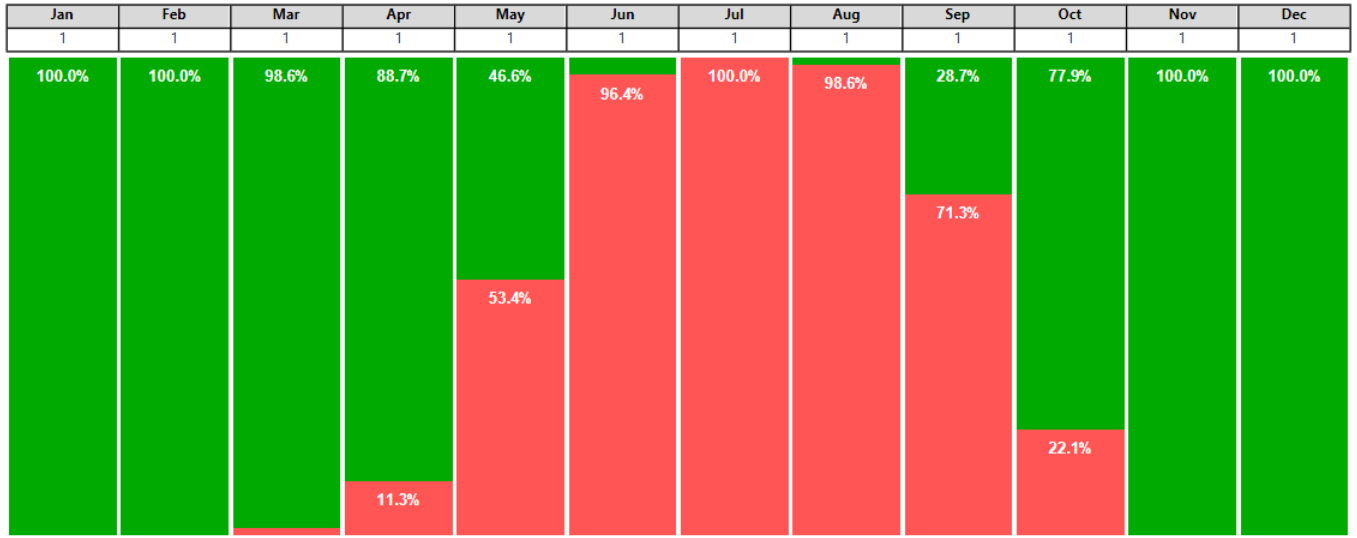
Overview of box performance for actual lane

	packaging	#	no excursions	cold excursions	hot excursions	hot&cold excur.
1	EPS all-season	1687	61.9%	0.0%	38.1%	0.0%
2	PU all-season	1687	99.9%	0.0%	0.1%	0.0%
3	PU summer	1687	0.0%	100.0%	0.0%	0.0%
4	VIP all-season	1687	100.0%	0.0%	0.0%	0.0%
5	VIP winter	1687	100.0%	0.0%	0.0%	0.0%

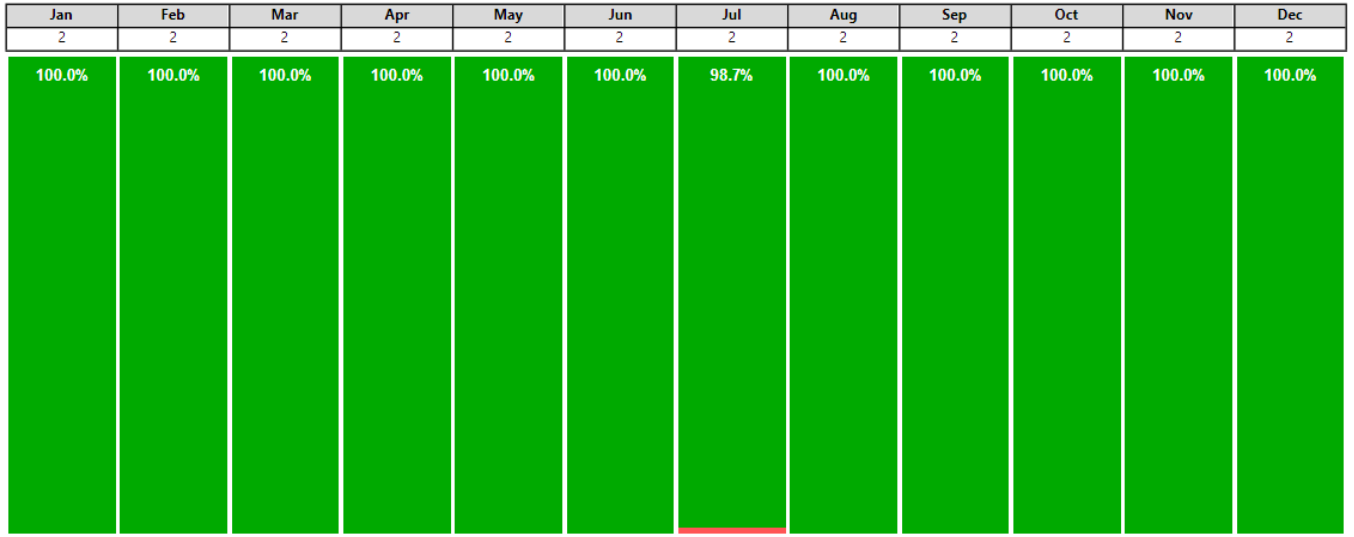
		packaging	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	☐	EPS all-season	●	●	●	●	●	●	●	●	●	●	●	●
2	☐	PU all-season	●	●	●	●	●	●	●	●	●	●	●	●
3	☑	PU summer	●	●	●	●	●	●	●	●	●	●	●	●
4	☐	VIP all-season	●	●	●	●	●	●	●	●	●	●	●	●
5	☐	VIP winter	●	●	●	●	●	●	●	●	●	●	●	●

EPS box is not compliant anymore!

Seasonality for actual lane

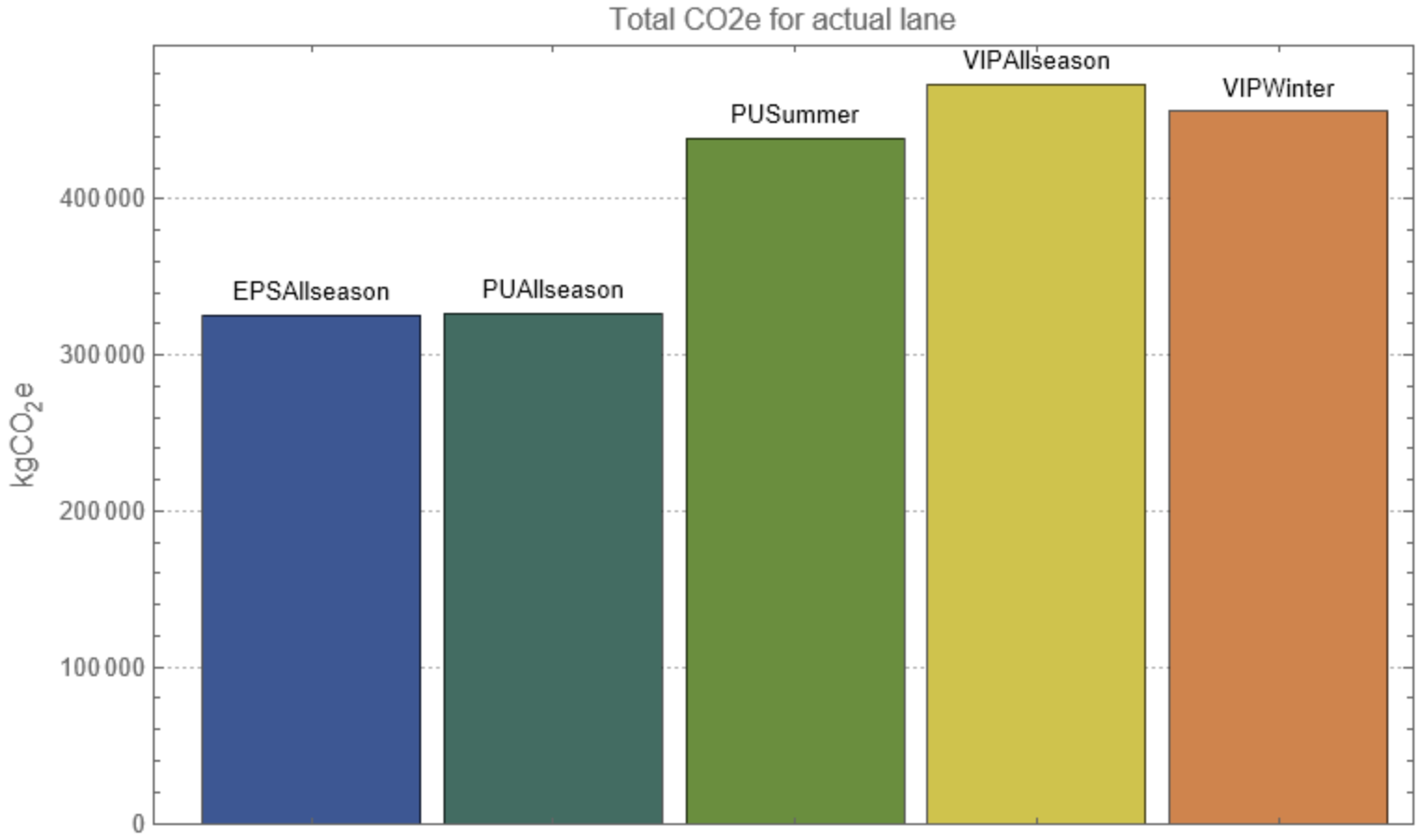


EPS all-season

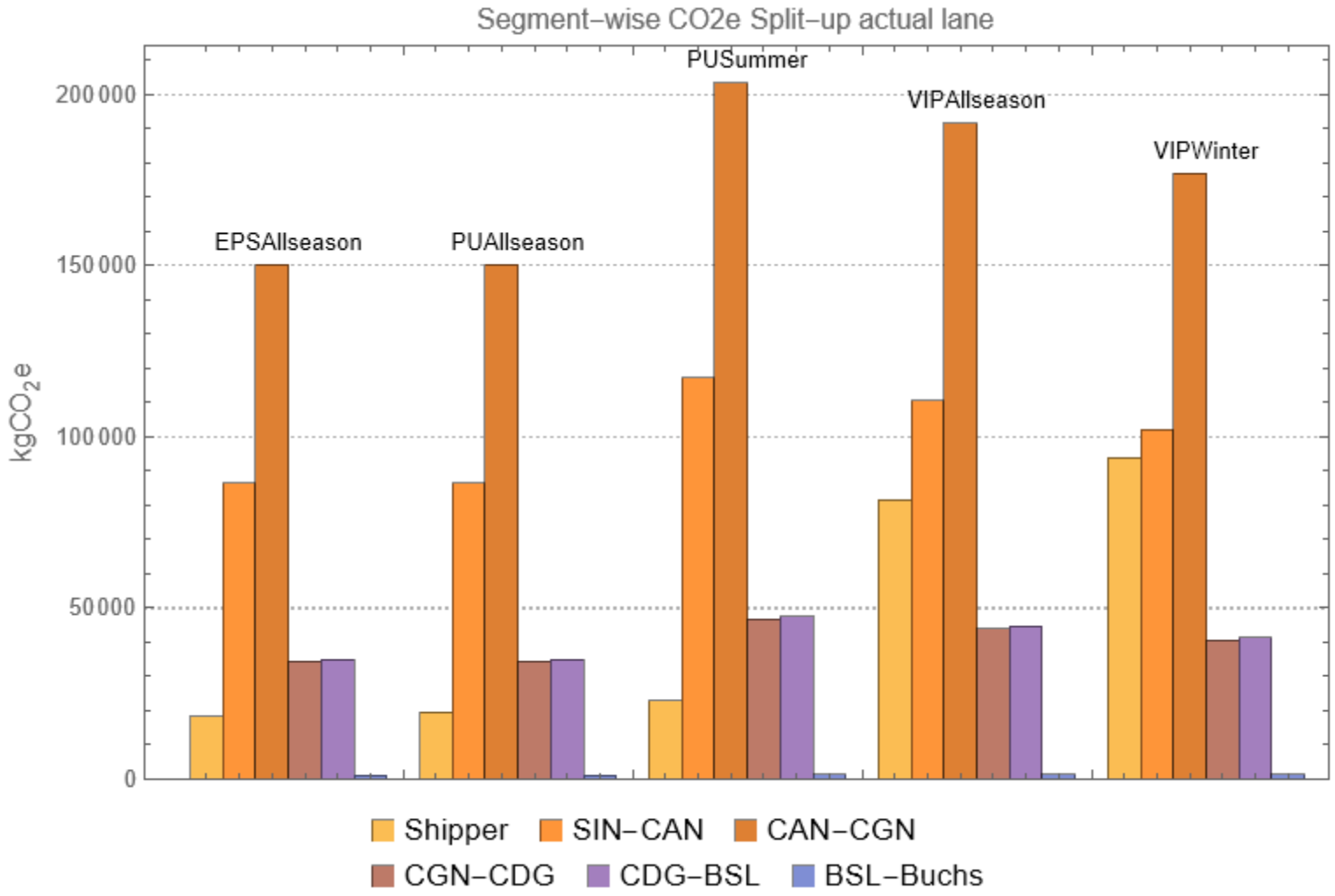


PU all-season

Carbon footprint comparison – actual lane

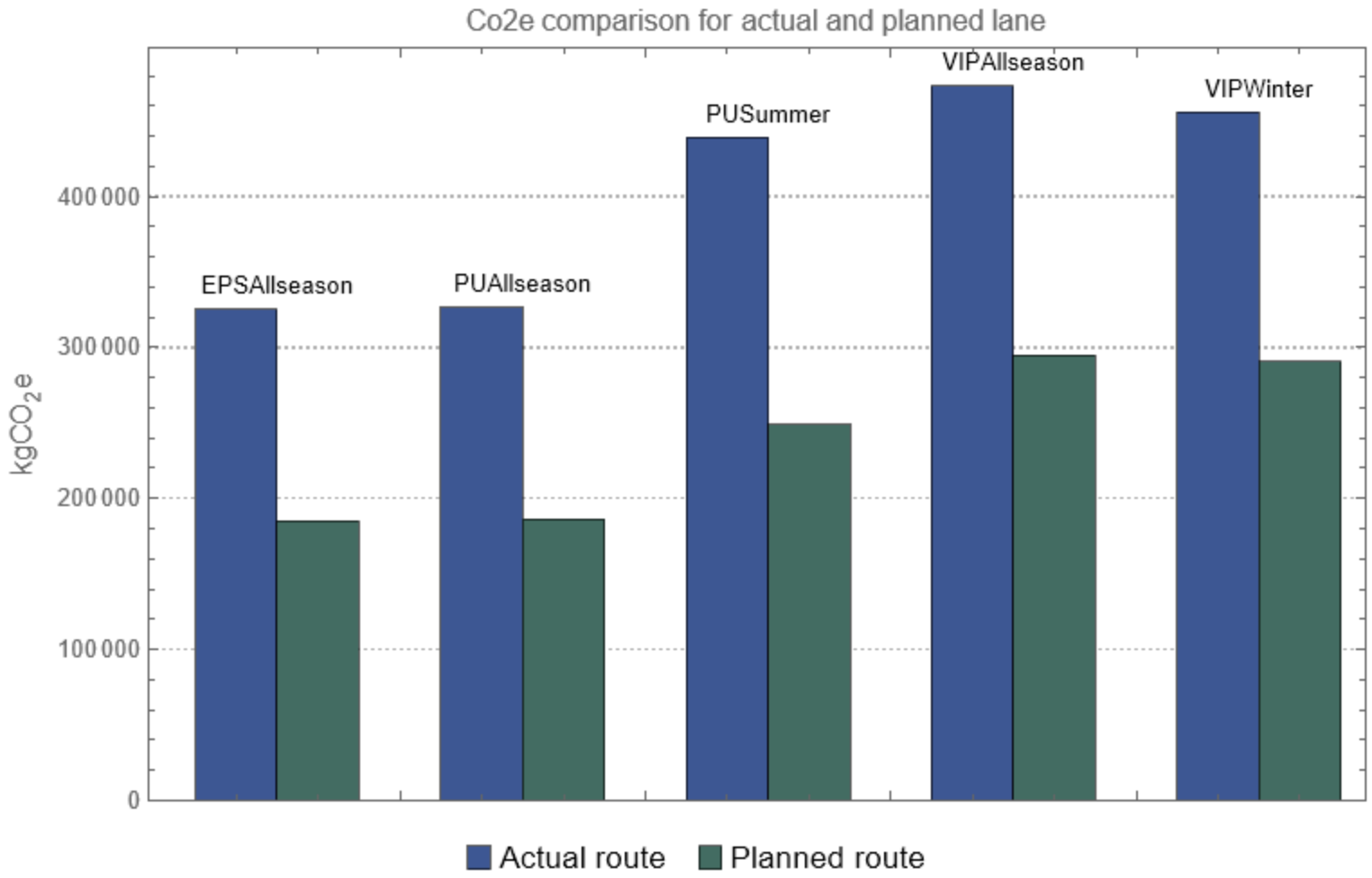


Segment-wise CO2 split up for actual route



Two long haul and two short haul flight segments gives high carbon footprint.

Comparison of carbon footprint



Comparison of best choice

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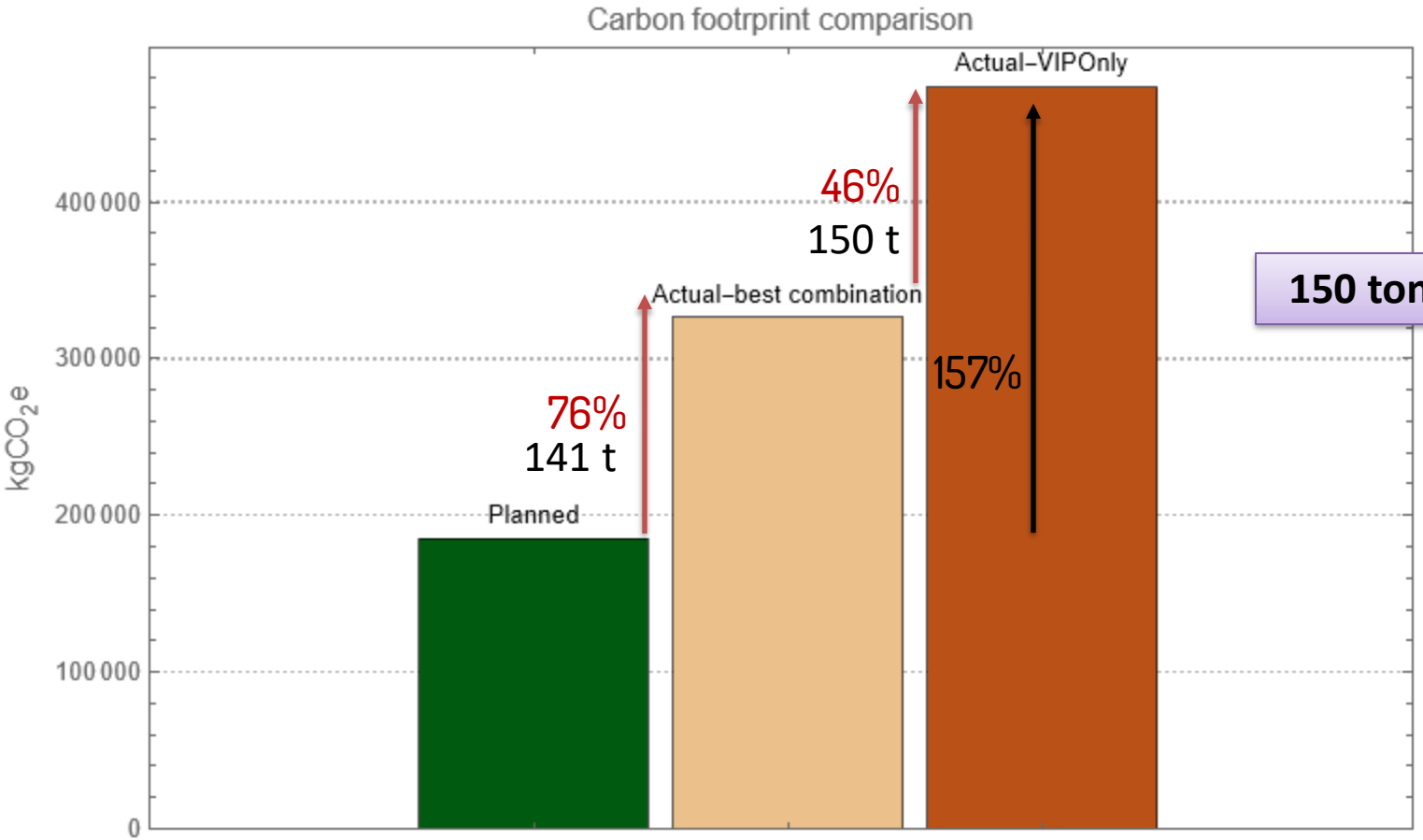


1 tonne CO2e equivalent to…

MUC-SF

35

150 tonnes

It's half of a new Central Park!

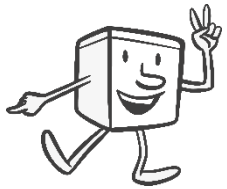
Key takeaways

Takes into accout the actual lane and improves base planning.

Specifically check for compliant solutions.

Recommends ways to reduce carbon footprint.

Minimize total costs while reducing carbon footprint.



Makes CO2 footprint comparison transparent and fair.