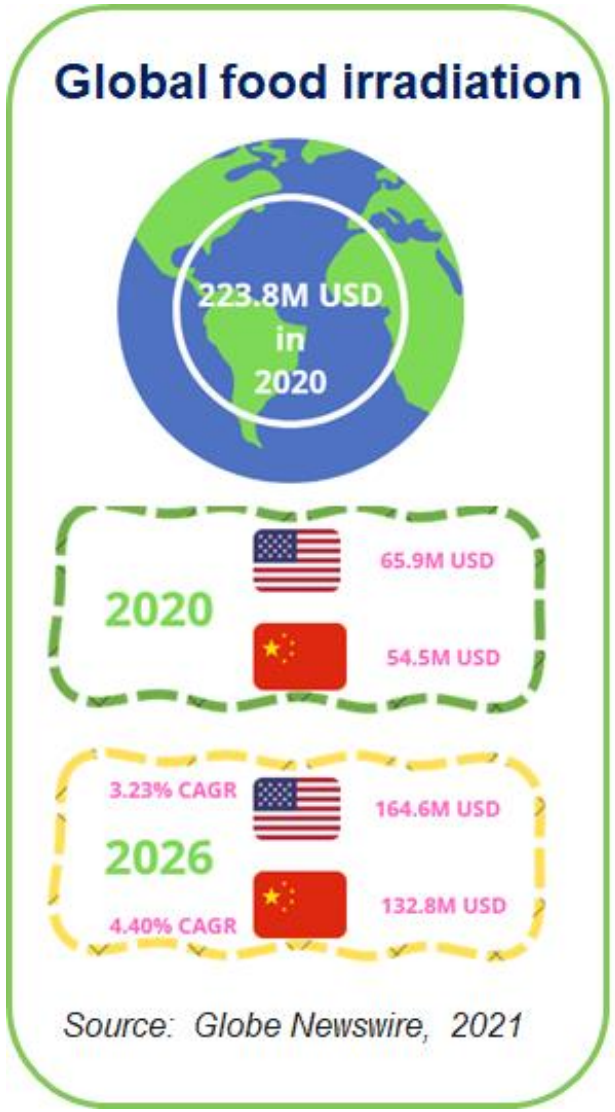
IFIS International Food Ionizing Processing Symposium

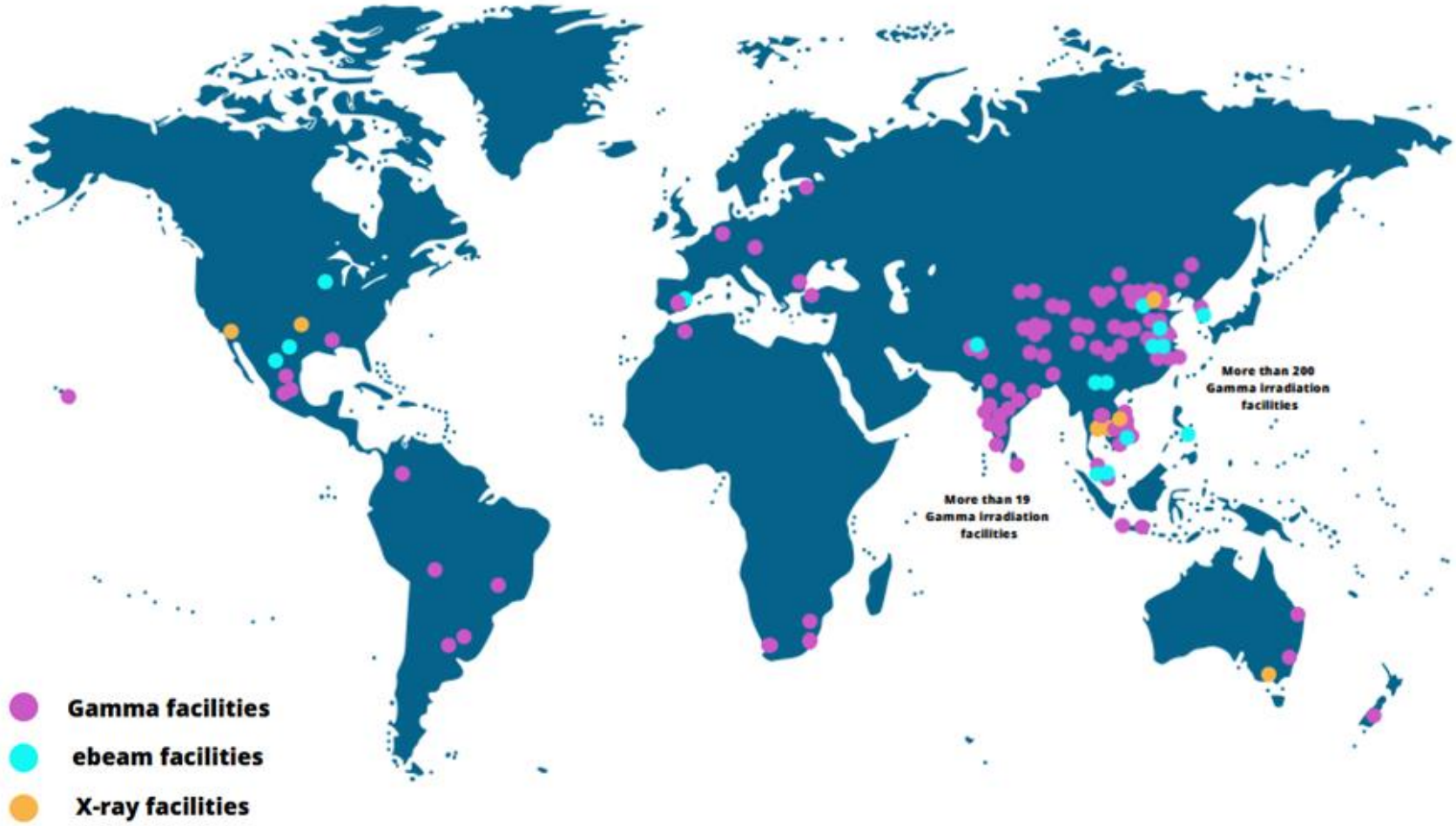
Cody Wilson / Frederic Dessy / Steven Robin Chabanne

X-Ray Solutions for Phytosanitary Applications

Fruit and Food Market

Food irradiation: global market





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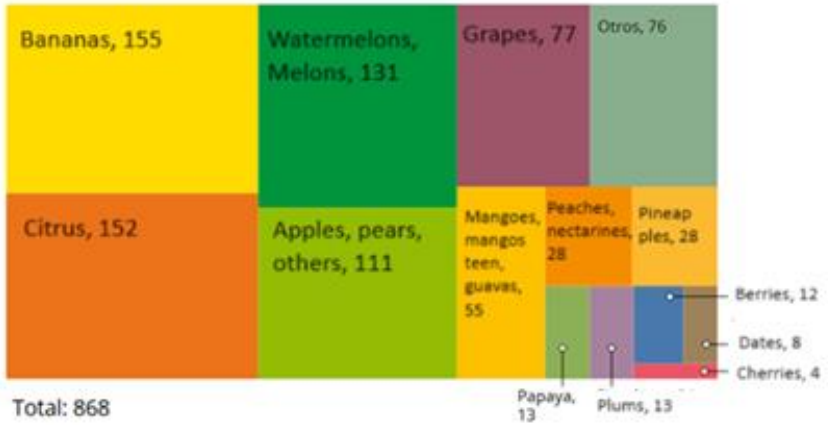
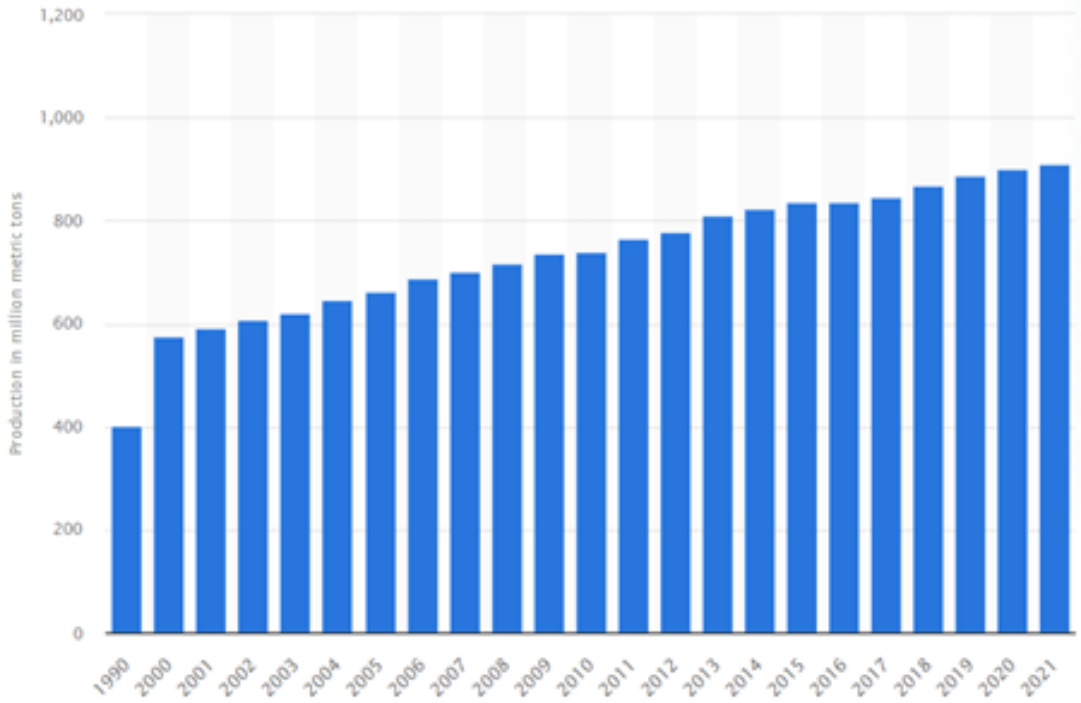
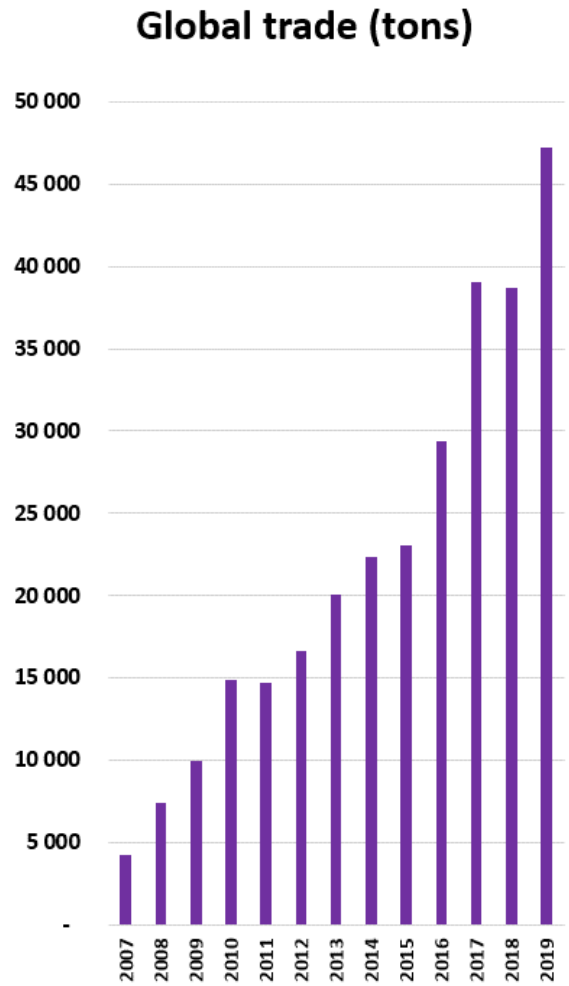
Fruit production worldwide

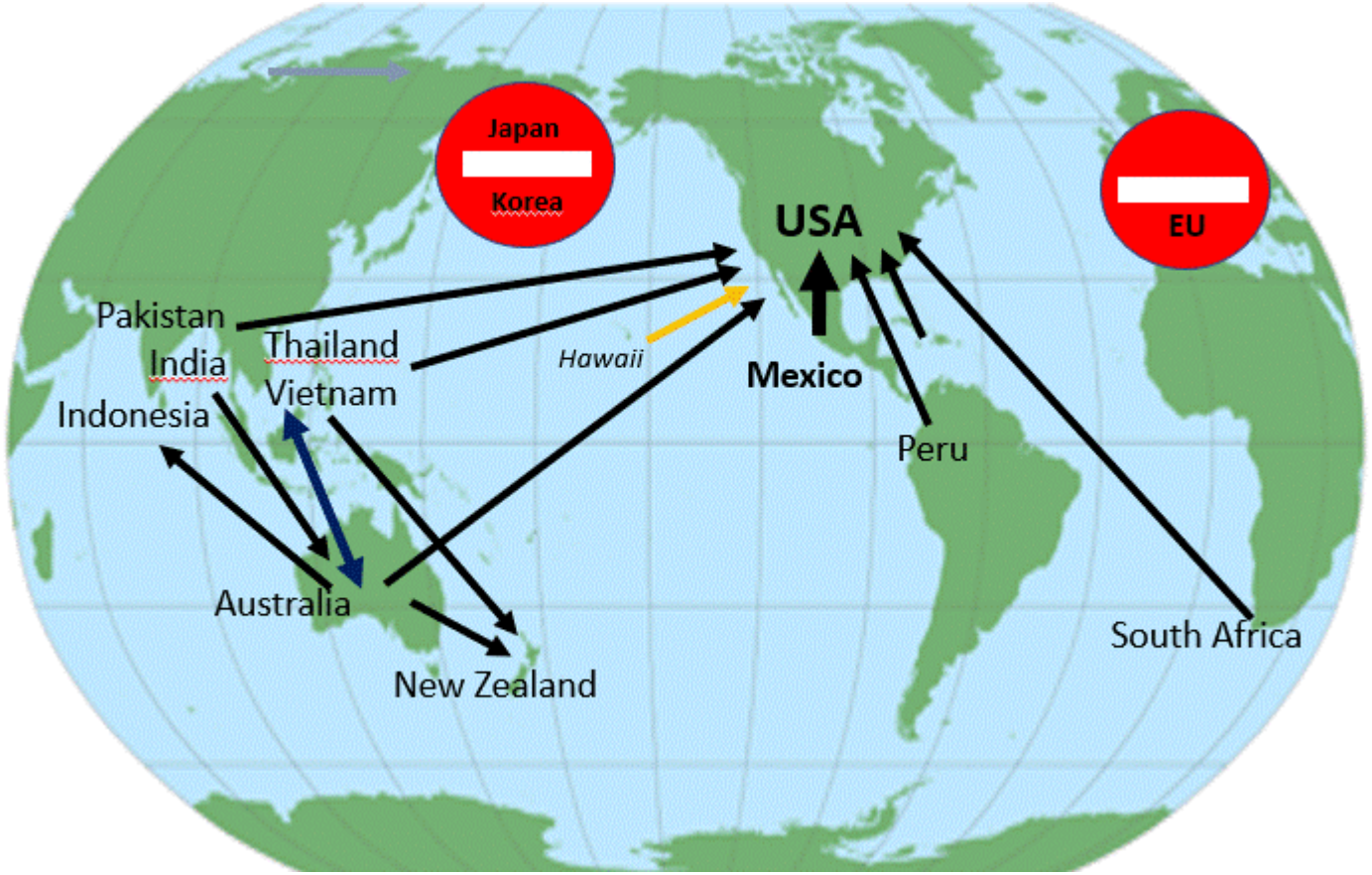




Fruit global production (MT), 2021
Source: FAOSTAT

Phytosanitary irradiation market

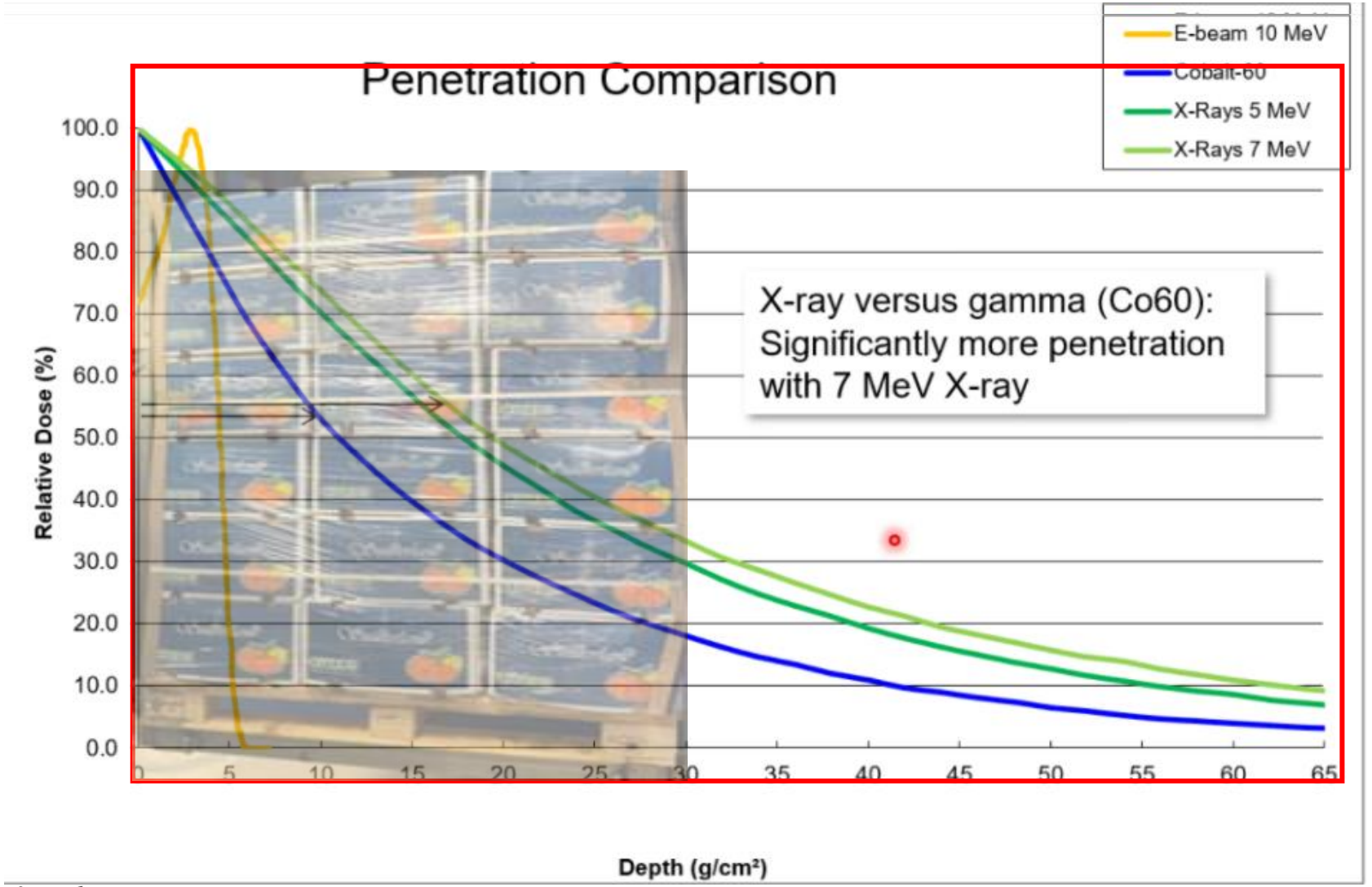




Source: Phytosanitary Irradiation Platform (PsIP)

X-Ray Processing : Be-Wide Solution

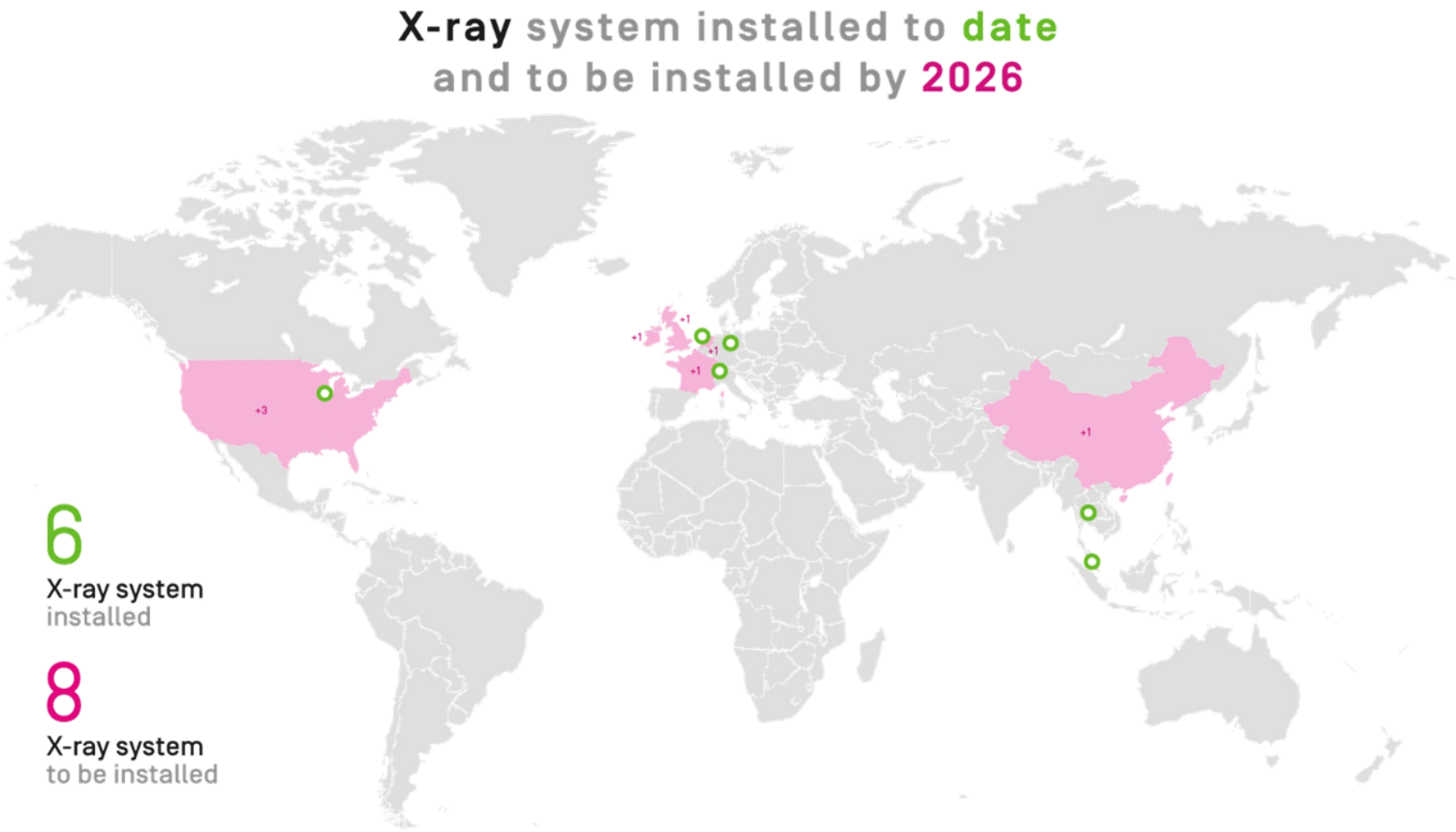
X-Ray Material Penetration



Courtesy of Steris

The change of paradigm

- From **2 to 20** accelerators per year
- From single e-beam accelerator to **integrated systems in both modalities**
- **From pioneers to Medical Device manufacturers**
- From European-centric customer base to global



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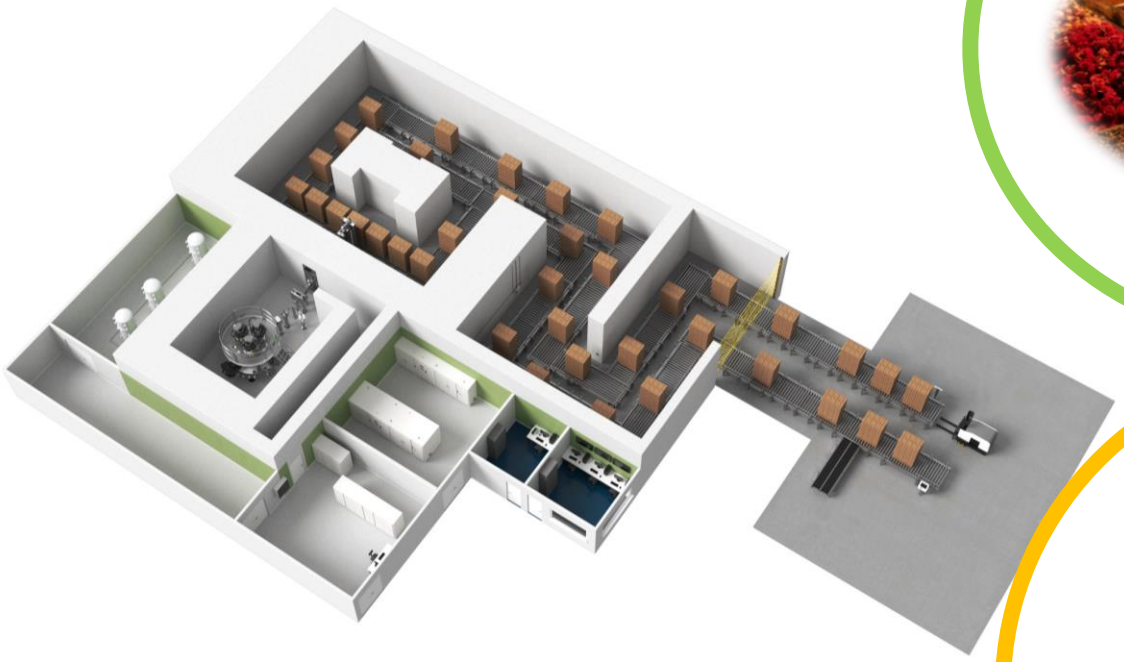
X-ray Product Handling System

Phytosanitary Processing System

Multipurpose facility



~ 10 kGy

25 kGy

150 Gy

400 Gy

< 1 kGy

~ 5 kGy

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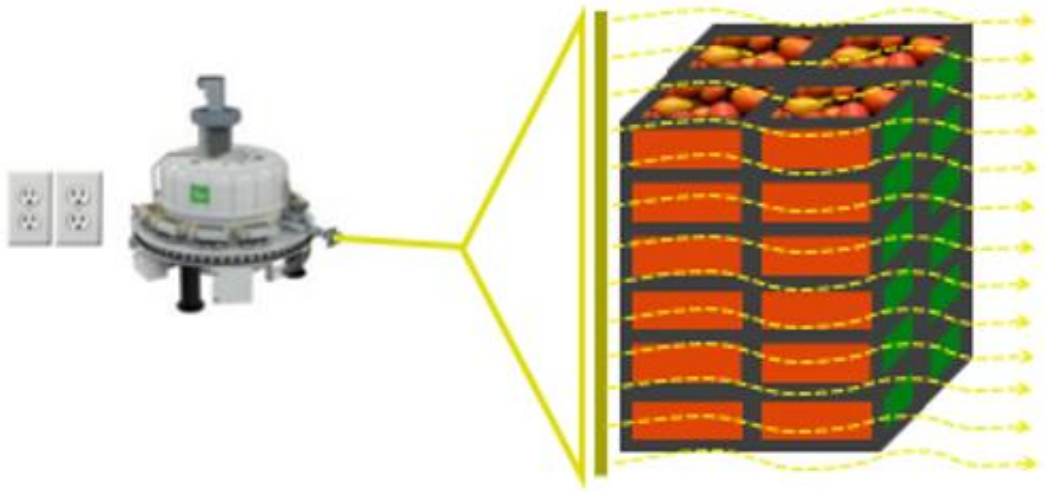
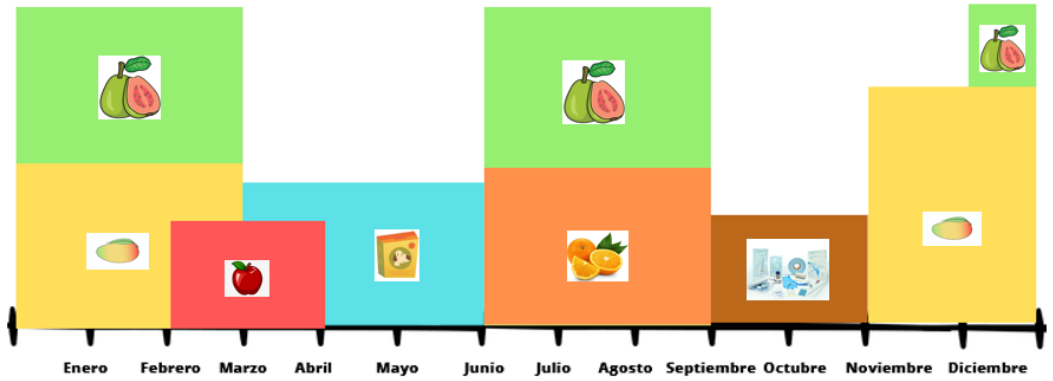
X-ray Be-Wide throughput estimation





Parameter	150 Gy	400 Gy	1 kGy	5 kGy	10 kGy	25 kGy
Min Dose[kGy]	0.16	0.42	1.2	5.3	10.5	25.8
Power [kW]	100	250	560	560	560	560
Conveyor speed [m/min]	3.5	3.5	3.5	3.5	3.5	3.5
Throughput [pallets/h]	~ 80	~ 80	~ 80	~ 20	~ 10	~ 7

High speeds due to low doses

Fixed speeds, multiple pass

US std pallets, 2.2 m, density 0.5 g/cc
X-ray (7 MeV) treatment, double sided

Throughput

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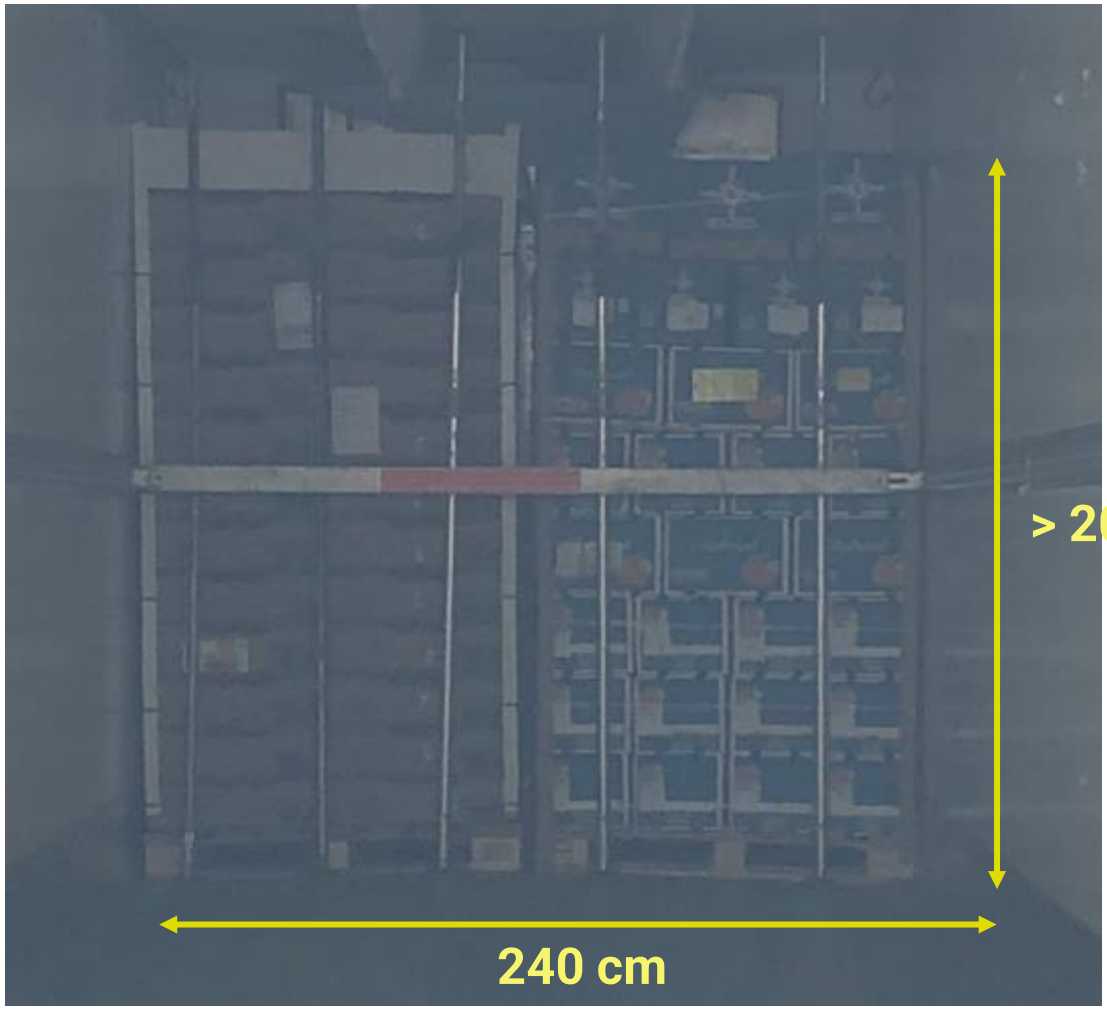
Collaborations : optimize product treatment

Experiment- Aerial

Pallet arrival:

Weight > 1 ton/pallet



Modeling - RayXpert

Dose rate & 3D Zoning calculation

CAD Import

Monte Carlo method

Xray Ebeam Gamma

INDUSTRIAL SOLUTIONS

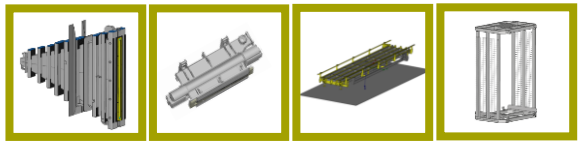
*A software solution that associates a **3D modeling** tool to a powerful computer **calculation code**.*
Initially develop for Radiation Protection, now used to forecaste the dose map in a product following a treatment

Modeling - RayXpert

INDUSTRIAL SOLUTIONS

IRRADIATION PROCESS MODELING

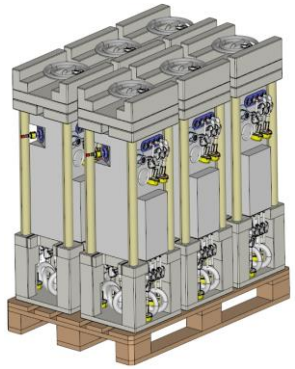
SITES SELECTION

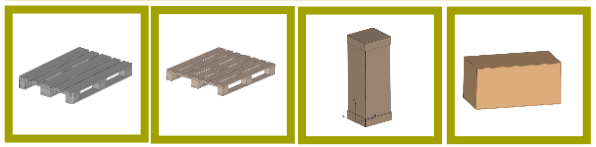


XRAY & EBEAM SOURCES

CONVEYING SYSTEMS

PRODUCT CAD

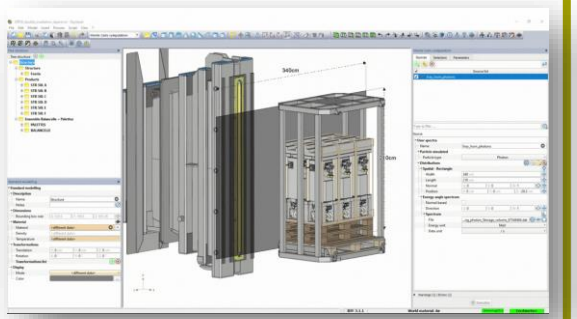




TRAY/PALETT

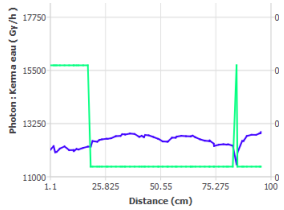
PRODUCT/BOX E

PROCESS SETUP

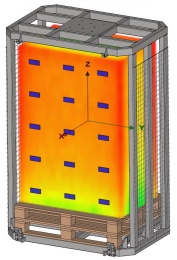


- Throughput
- Speed
- Single side
- Double side
- Uniform Scan
- Variable Scan
- Double Row
- Double Level

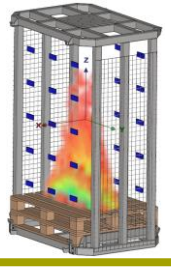
DOSE MAP ANALYSIS



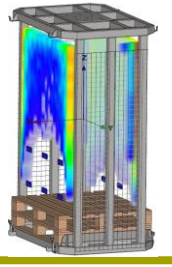
DUR



Dmin



Dmax



INCLUDED DATABASES

RESULTS

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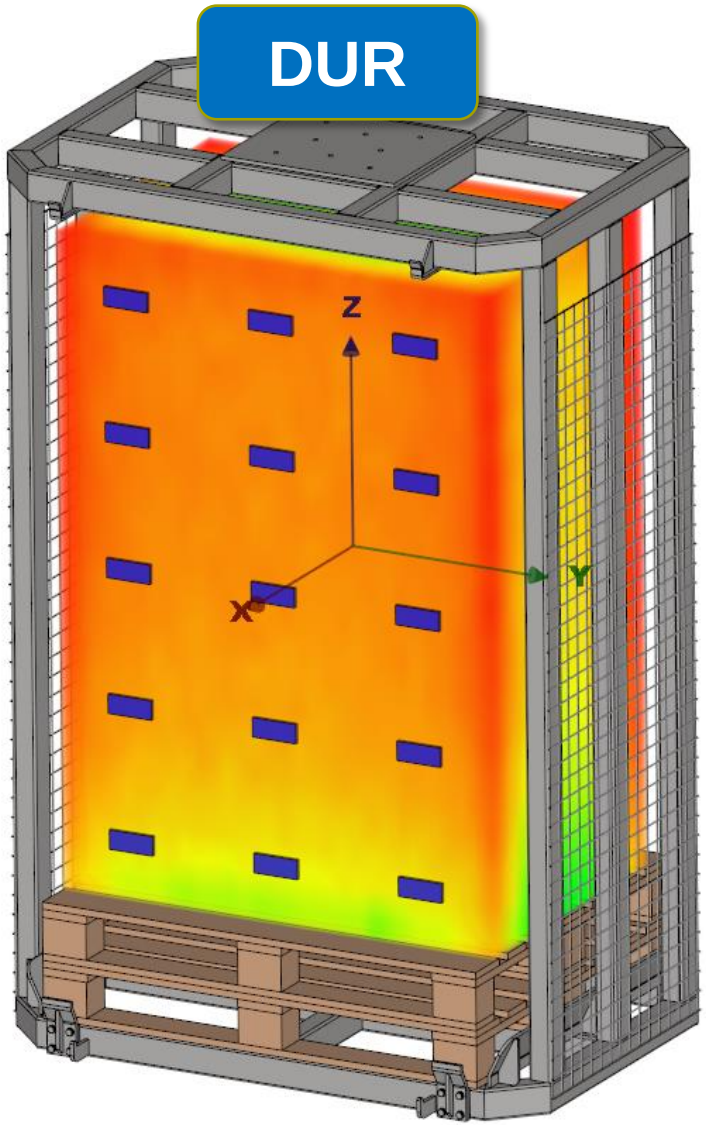
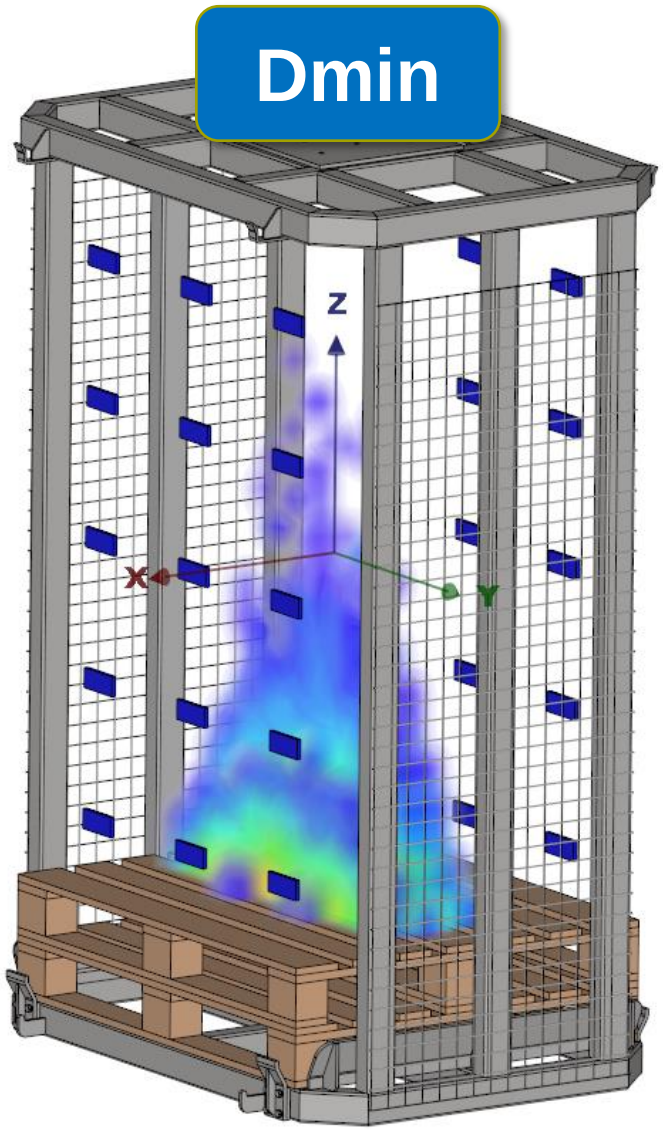
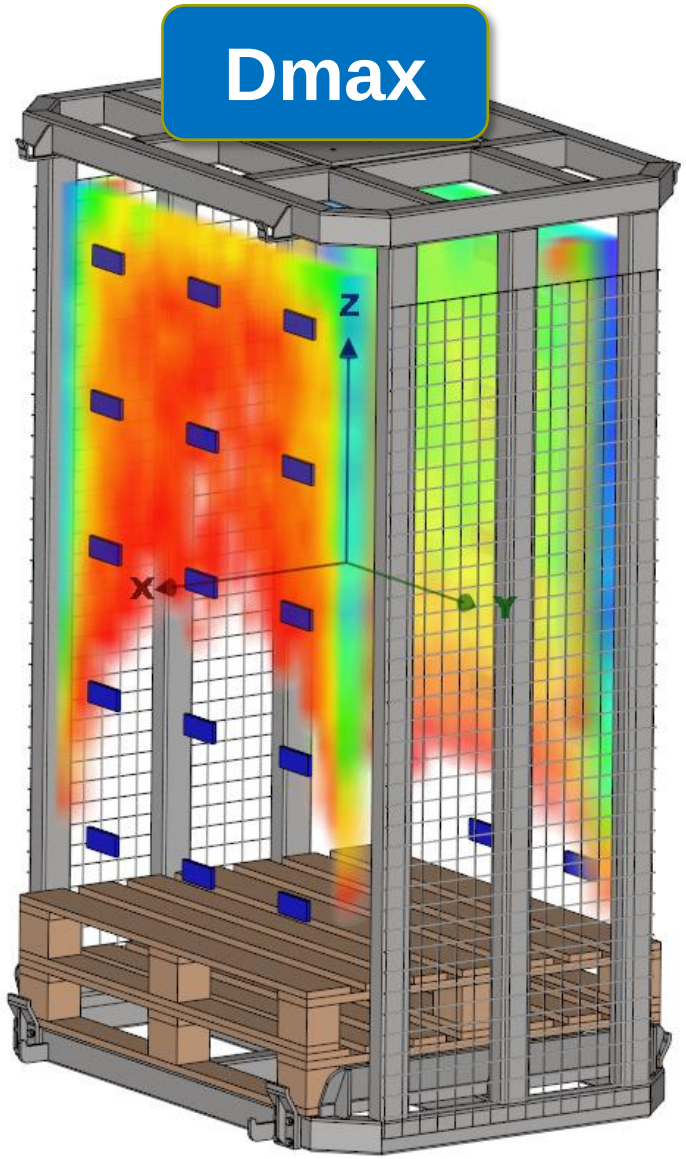
Modeling - RayXpert



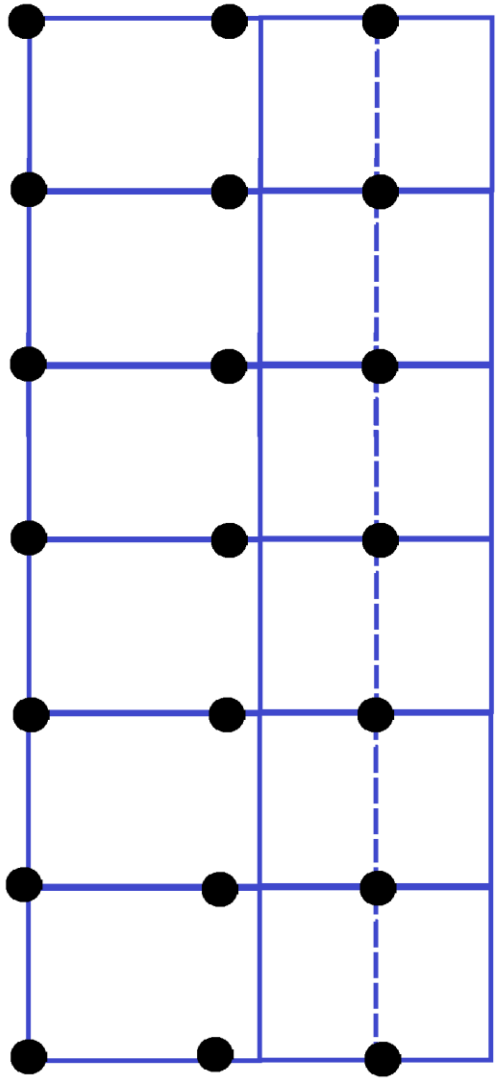




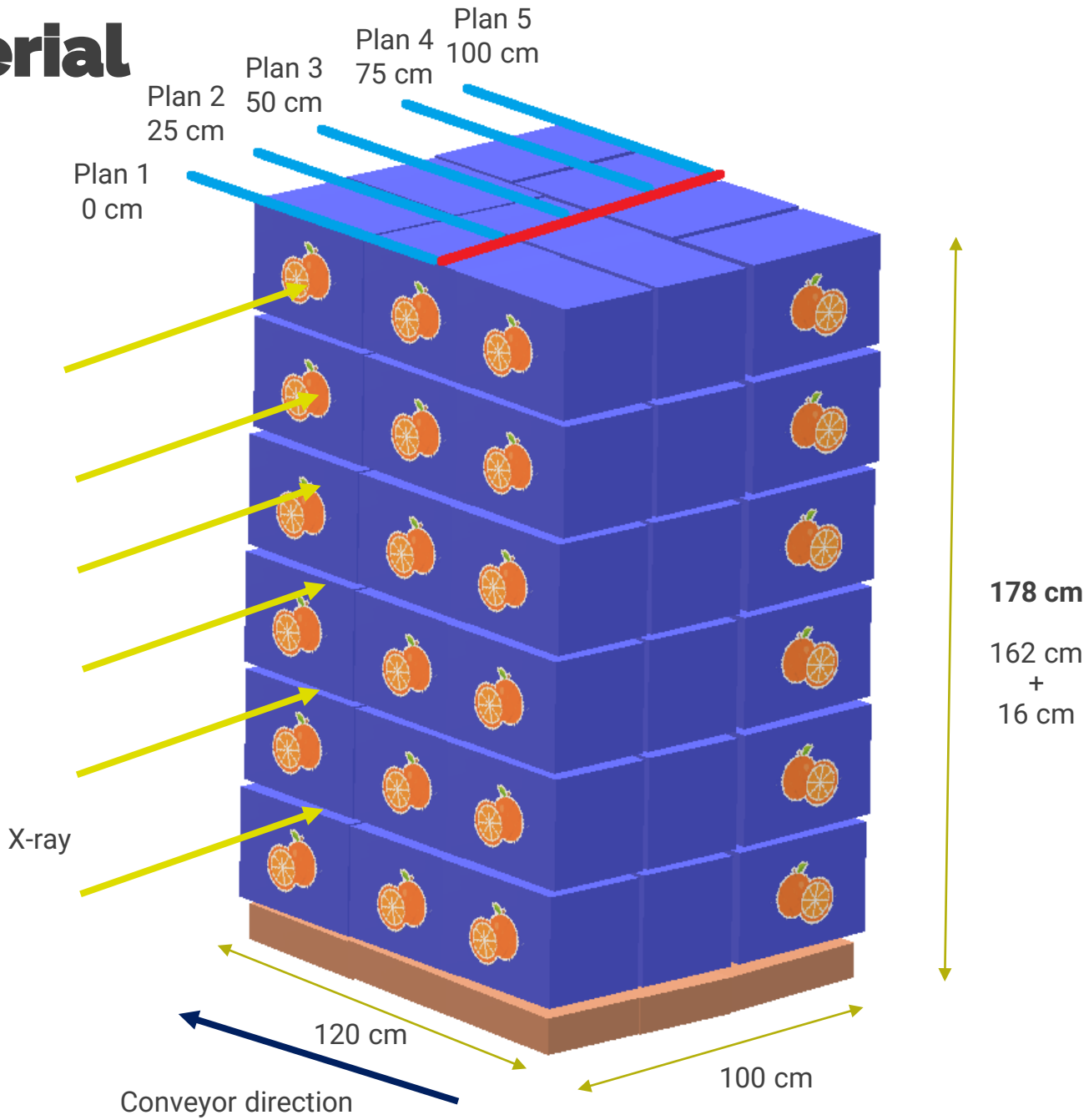
Irradiation conditions - Aerial

Uniform scan

X-ray
Double sided
Energy: 7 MeV
Current: 5 mA
Conveyor speed: 1 m/min



Front view



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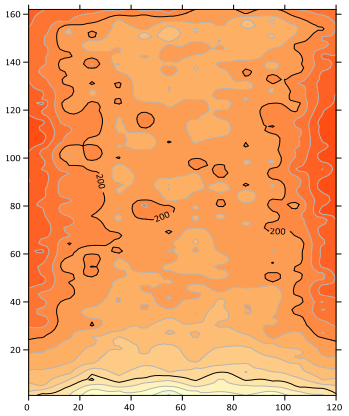
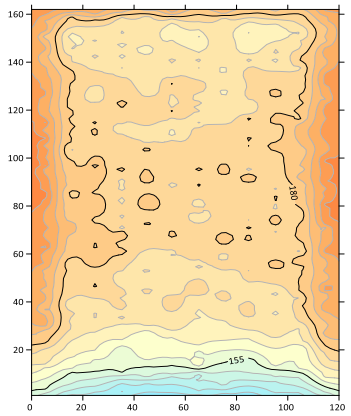
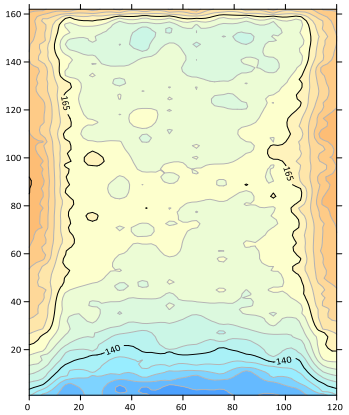
Oranges - Result

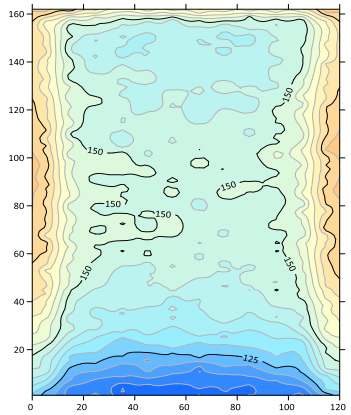
Dose Mapping DUR = 2.23
Monte Carlo DUR (TRAD) = 2.21

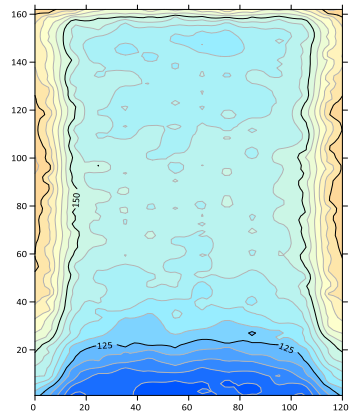
Oranges: Closed box – 7 MeV – Uniform Scan – uncentered pallet

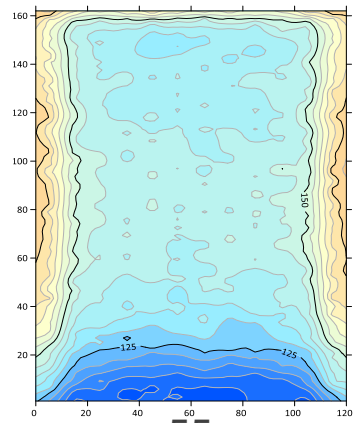

5 cm

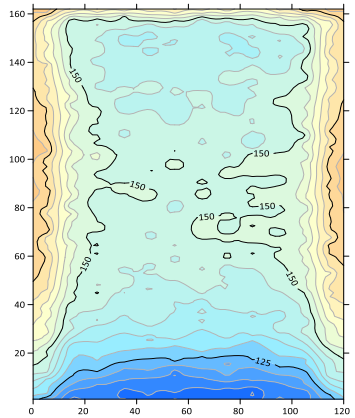

15 cm

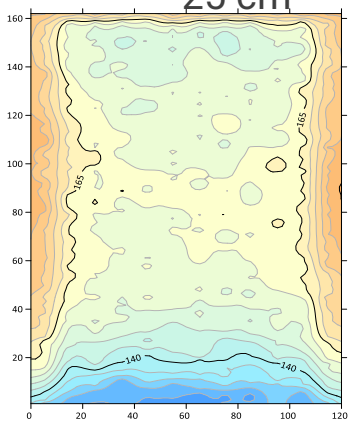

25 cm

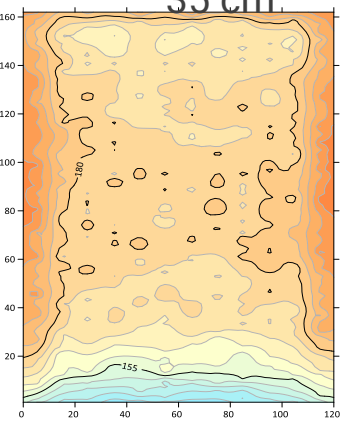

35 cm

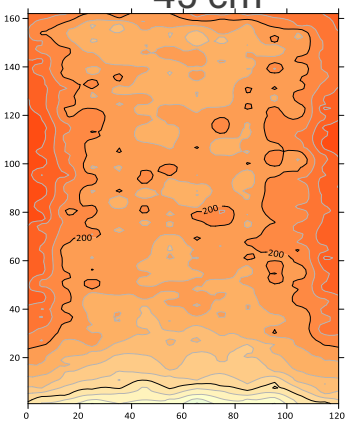

45 cm


55 cm


65 cm


75 cm


85 cm


95 cm

Height: 162 cm
Density: 0.475 g/cm3
Overscan: ~ 26 cm/6 cm

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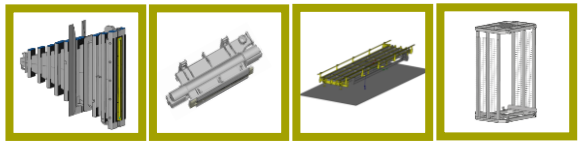
Modeling for a specific case

IRRADIATION PROCESS MODELING

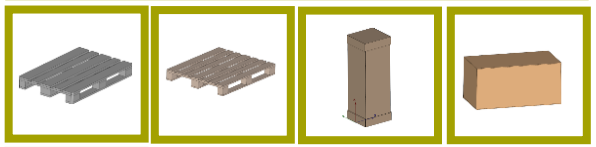
SITES SELECTION



XRAY & EBEAM SOURCES

CONVEYING SYSTEMS

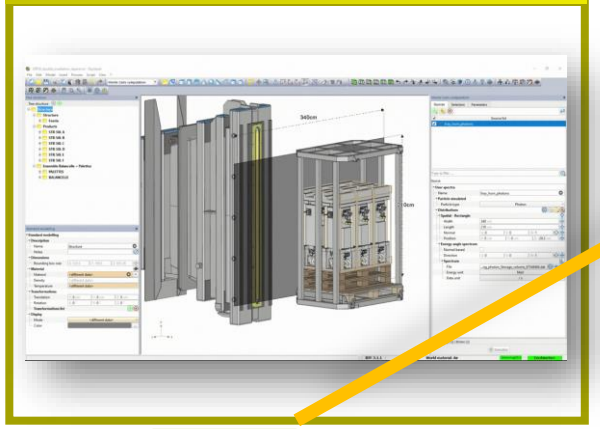
PRODUCT CAD



TRAY/PALETT

PRODUCT/BOX E

PROCESS SETUP



Throughput

Speed

Single side

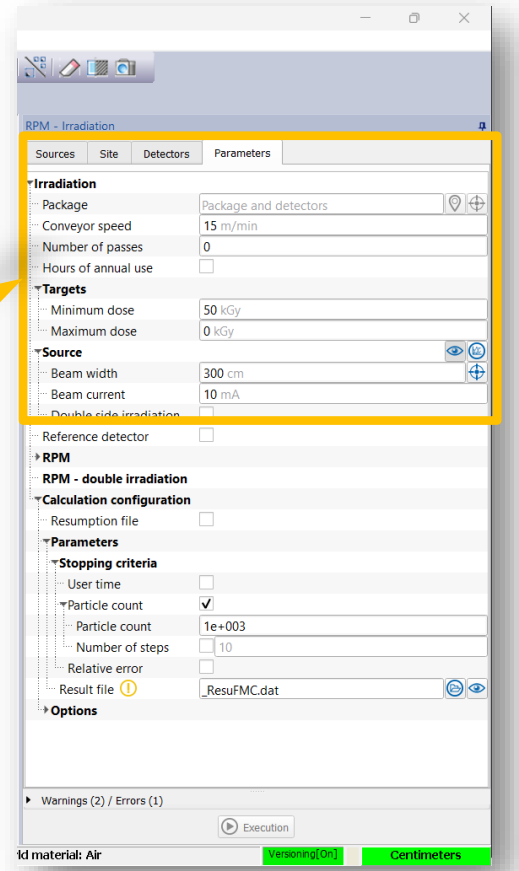
Double side

Uniform Scan

Variable Scan

Double Row

Double Level



INCLUDED DATABASES

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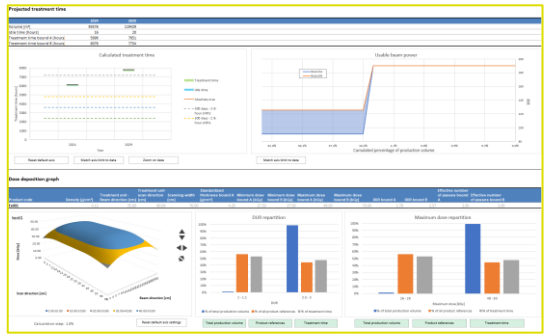
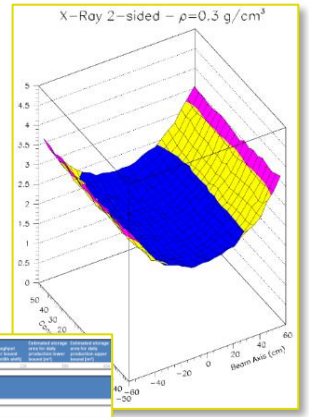
Custom solution to match your needs : Pre-Engineering service

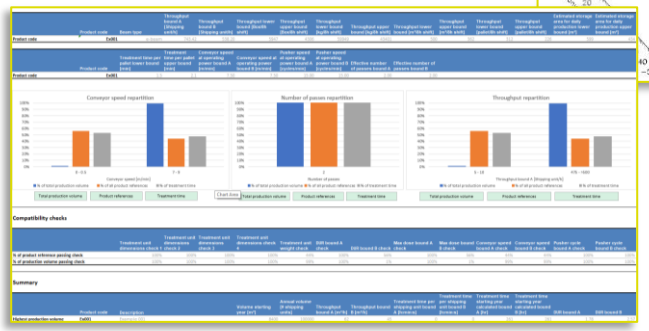
① **Simulate** based on products and industrial vision

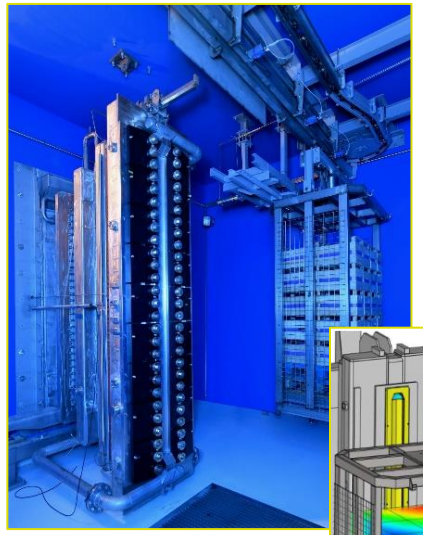
② **Test, optimize** and specify sub-systems

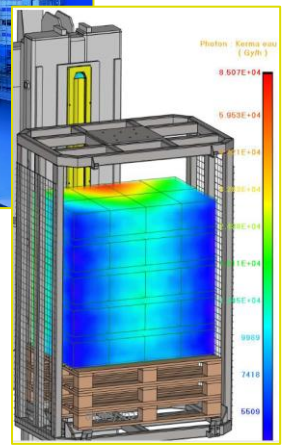
③ **Detailed design** in Interface Building Document, including bunker & all sub-systems

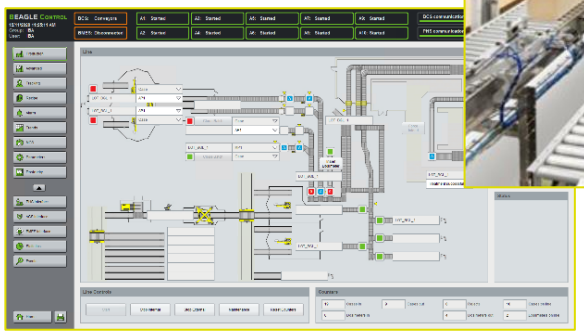












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Thanks.