

EB technology vis-a-vis Gamma radiation for Radiation sterilization: Emerging scenario

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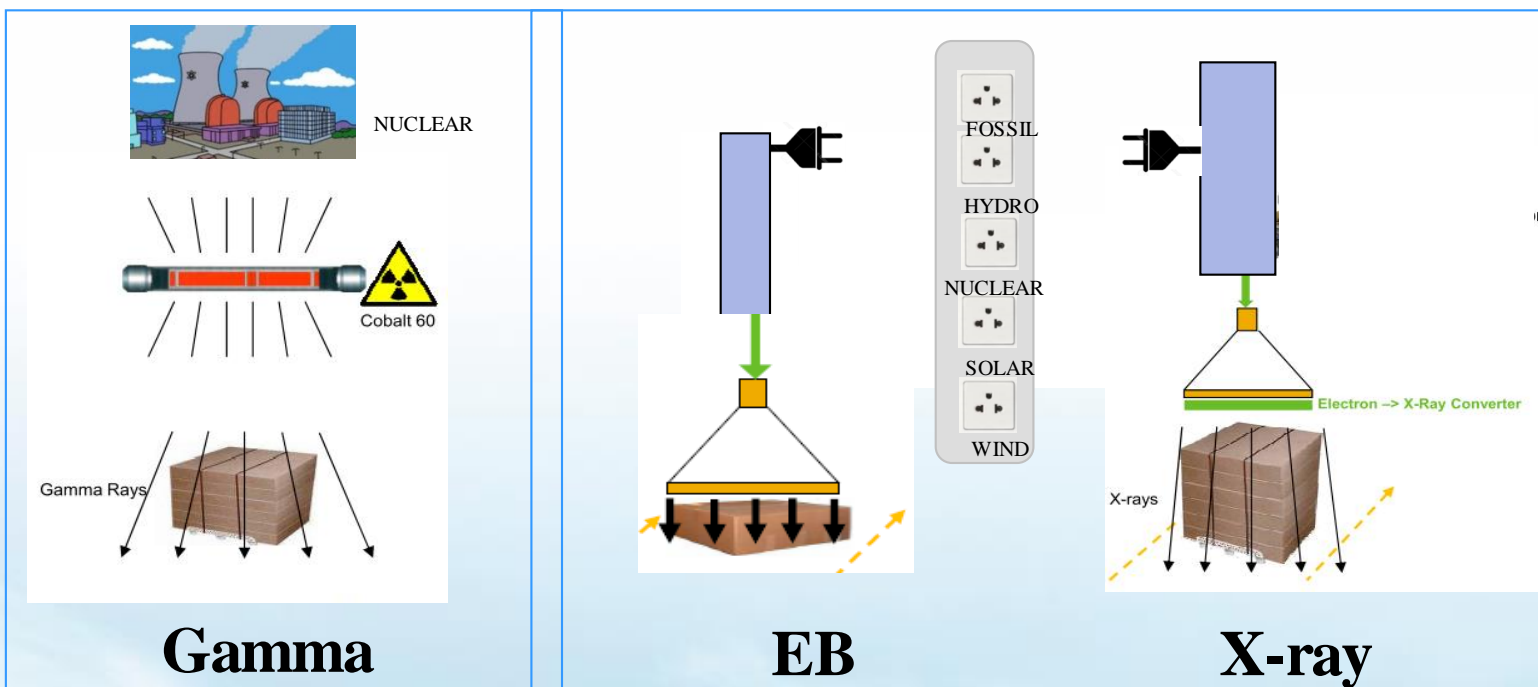
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A08-05

- Radiation sources: gamma, EB, X-ray
- Product conveyor system
- Radiation shielding and safety interlock system
- Process control system
- Auxiliary system



Energy	1.25MeV Gamma	5-10MeV EB	5-7.5MeV EB
Directions	4π	One direction	One direction
Main Consumption	12.5% Co-60	High power	Very high power



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EB accelerator-Linac

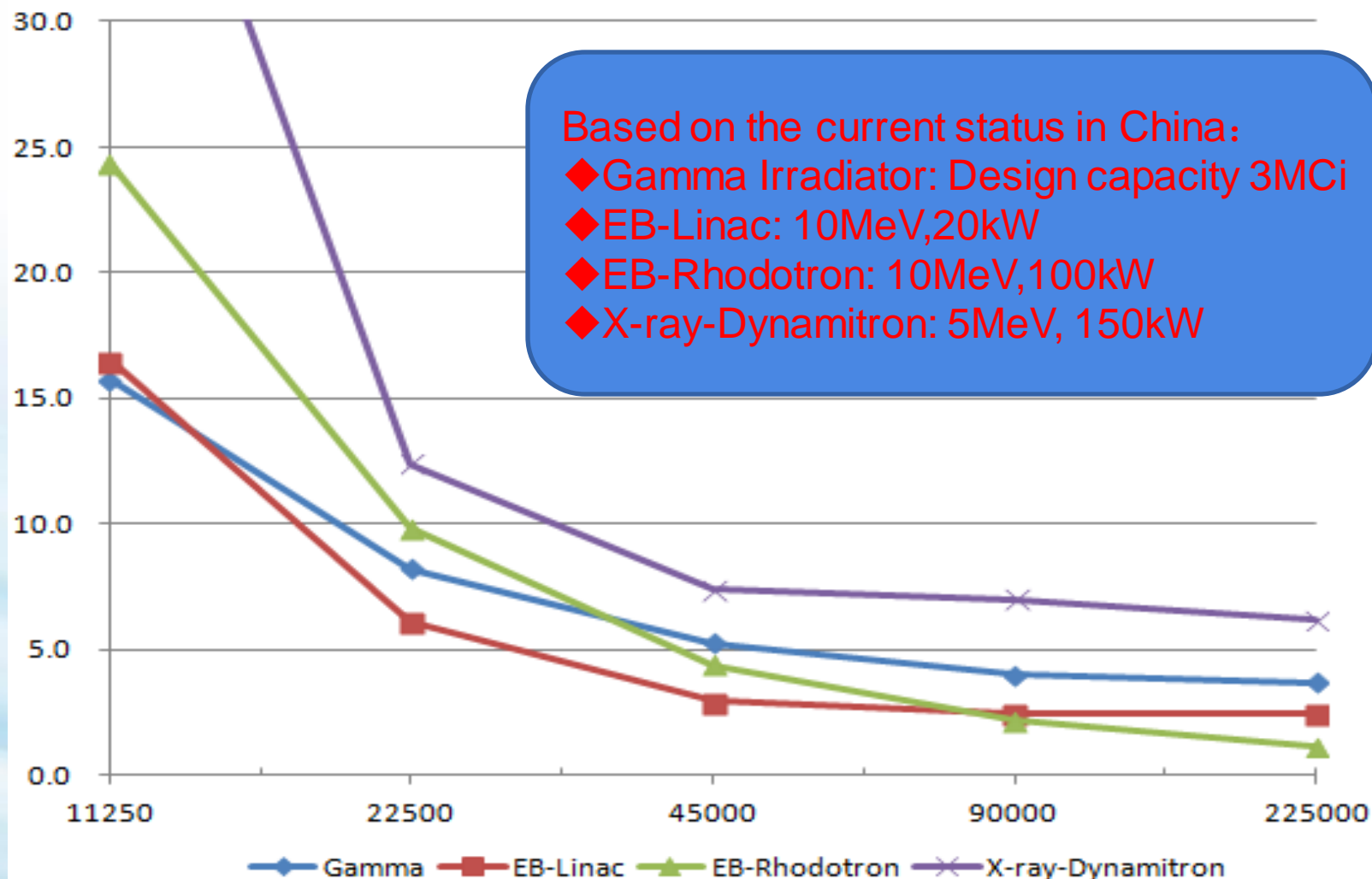
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	Gamma	EB	X-ray
Radiation emission	All time	No radiation when powered off	
Nuclear security	yes	No	
Transportation issue	yes	No	
Radioactivity waste	yes	No	
Regulation requirements	Very Strict	Relative simple	
Penetration	Good	Low	Very good
System complication	Simple	Complicated	Very complicated
Operation	Simple	Complicated	Very complicated
Maintenance	Easy	Difficult	Difficult
Development status	Developed	Developing	Emerging

Payback period: years



m³/y

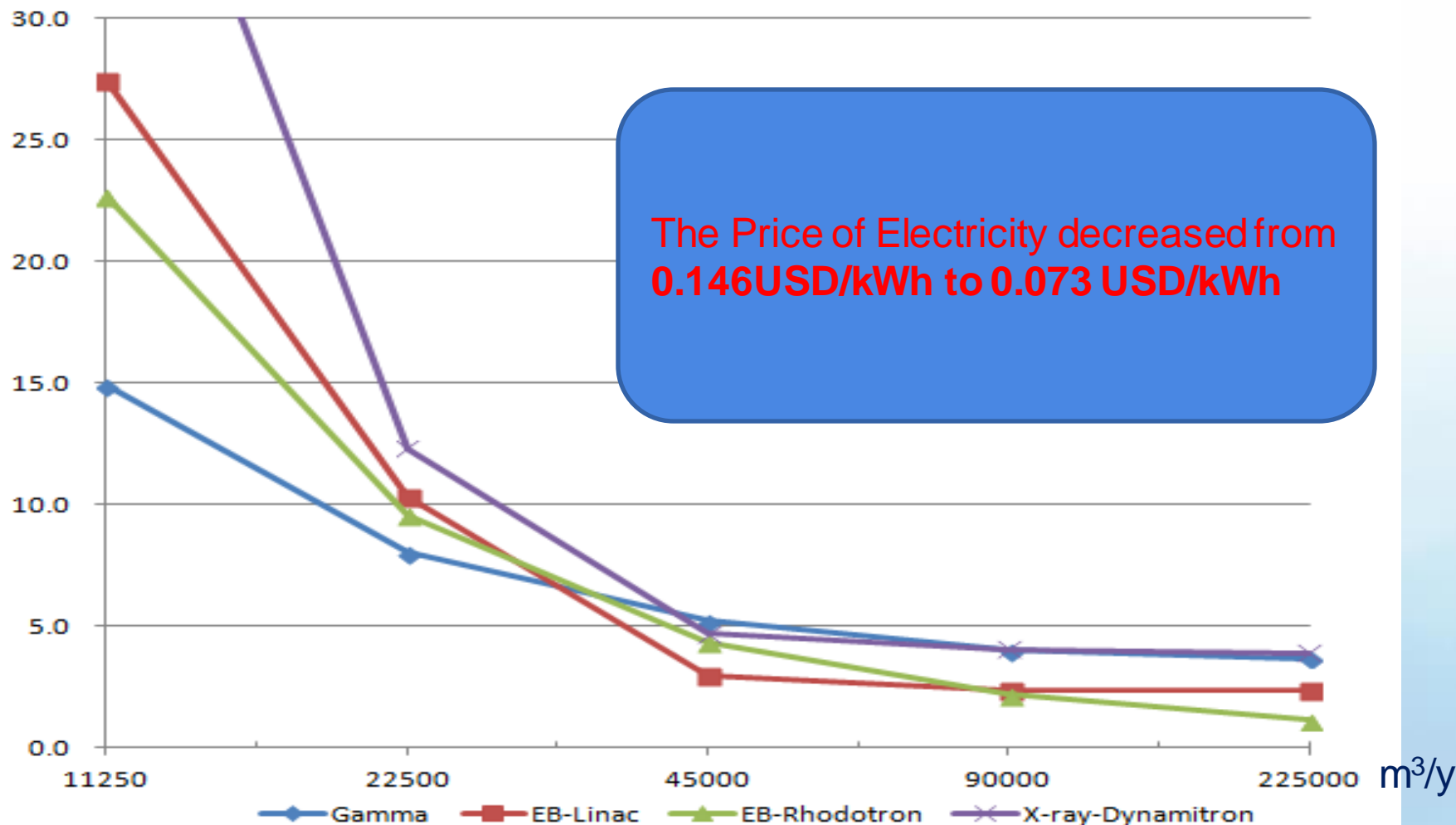
- The Gamma is most economical than EB and X-ray when the throughput is less than $14000\text{m}^3/\text{y}$, the Co-60 activity to meet this throughput is around 500-600 kCi: Meets current status-130 gamma with average source loading at 500-600kCi in China
- The EB-Linac is most economical when the throughput is between $14000\text{m}^3/\text{y}$ and $80000\text{m}^3/\text{y}$: Meets the developed situation and the trend
- The EB-Rhodotron is most economical when the throughput is higher than $80000\text{m}^3/\text{y}$: Too huge throughput for Chinese market
- X-ray is non economical at the moment in China

Technology combination	Economically competitive	initial investment	Main advantages	Main challenges
Gamma+Gamma	Strong now Will decrease	Low	Experience Acceptance	Source price and disposal Security
Gamma+EB-Linac	Very strong	Medium	Best for old gamma players Demonstration	Source Security
EB-Linac+EB-Linac	Strong	High	Best for new players	Do not cover all product
EB-Linac+X-ray	Low but will increase	High	Cover all product	Low efficiency

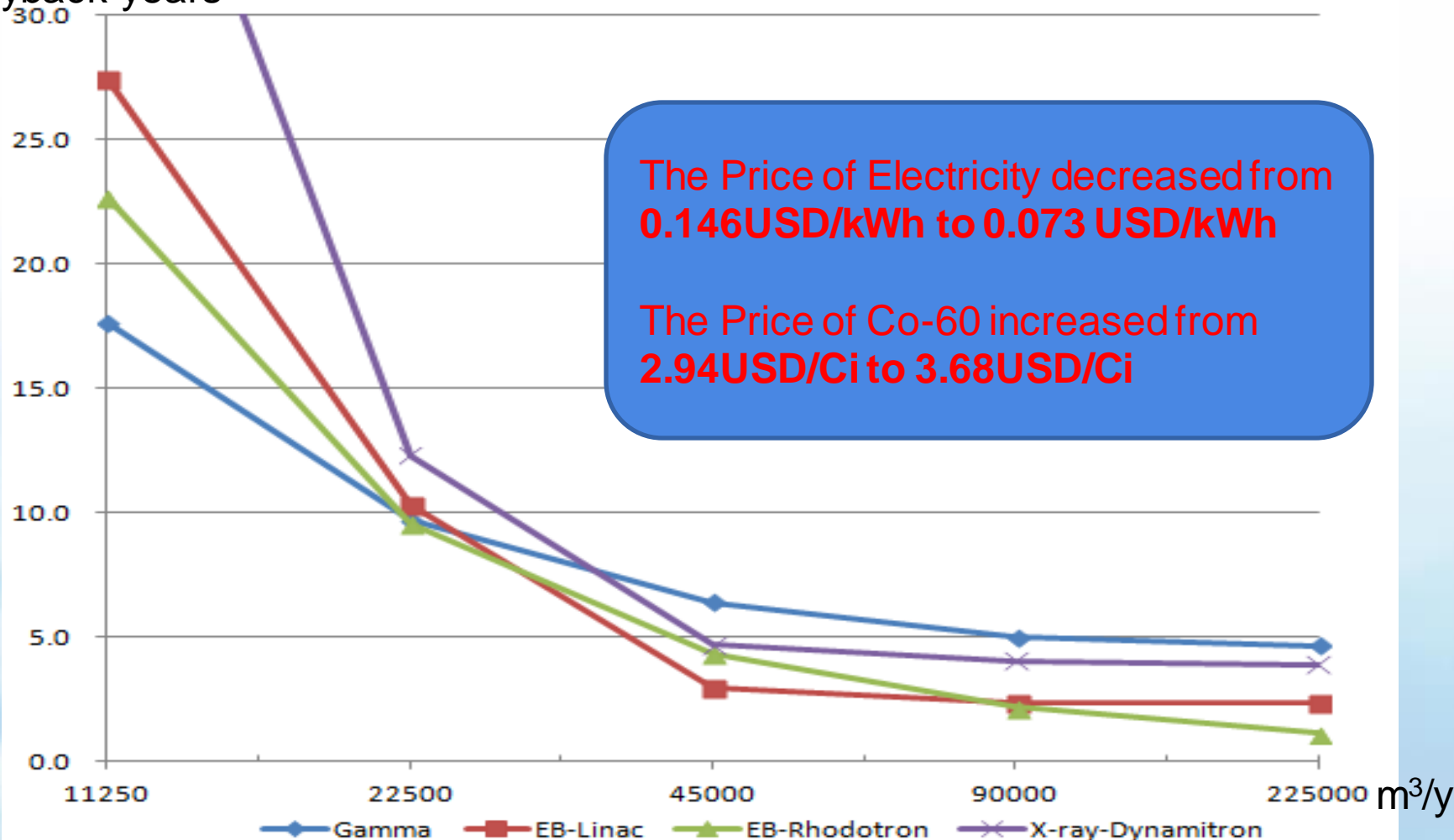


- The analysis is based on **same quantities of processed product**:
 - Similar income
 - Similar manpower
- The key factors impacting the investment payback period:
 - **The price of electricity**
 - The cost of the EB machine
 - The cost of Co-60 and the disposal
 - The efficiency of the conversion target

Payback-years



Payback-years



- Different development stages and different countries may have their optimal choice for the radiation technologies:
- **Developed stage:** the EB-Rhodotron and X-ray may develop fast, but the gamma will be still the dominant technology in the medium term
- **Well developing stage:** the EB-Linac and X-ray may develop very fast, and possible to be the dominant technology
- **Initial stage:** Gamma and EB-Linac may be the best choice



- The different technologies have different advantages and also drawbacks and will also change themselves
- From market and economical aspects, the different technologies have relative competitiveness, and this will be vary for different development stages and different countries
- *Survival of the fittest*
- The policy and regulation may guide and speed up the combination or alternative radiation technology in the radiation sterilization industry



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Thanks

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