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# Economics of Decommissioning

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# Decommissioning approaches

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IAEA has defined 3 options for decommissioning:

- ① **Immediate Dismantling** (or Early Site Release): the facility is removed from regulatory control relatively soon after shutdown. Final dismantling or decontamination activities can begin within a few months or years, depending on the facility.
- ② **Safe Enclosure** (or deferred dismantling): after shutdown the facility is maintained and monitored in a safe condition (spent fuel and liquid waste are removed) for a longer period, usually in the order of 40 to 60 years; dismantling and decontamination activities occur after residual radioactivity has substantially decayed.
- ③ **Entombment**: after shutdown the facility is put into a condition (spent fuel and liquid waste are removed) that will allow the remaining radioactive material to be kept on-site. This option usually involves reducing the size of the area where the radioactive material is located and then encasing the facility in a long-lived structure such as concrete, that is maintained and monitored for a period of time to ensure the remaining radioactivity is no longer of concern.

# Decommissioning approaches

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Each approach has its benefits and disadvantages. National policy determines which approach or combination of approaches is adopted or allowed.

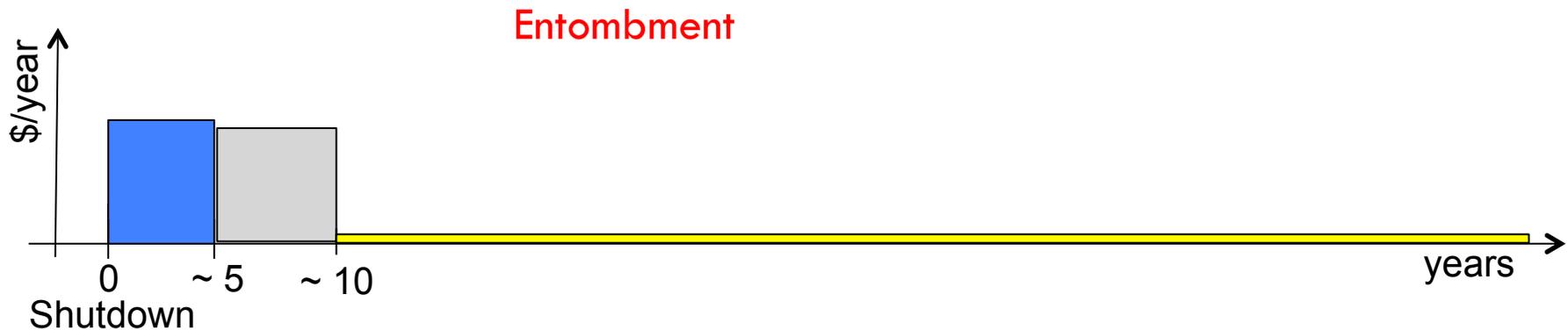
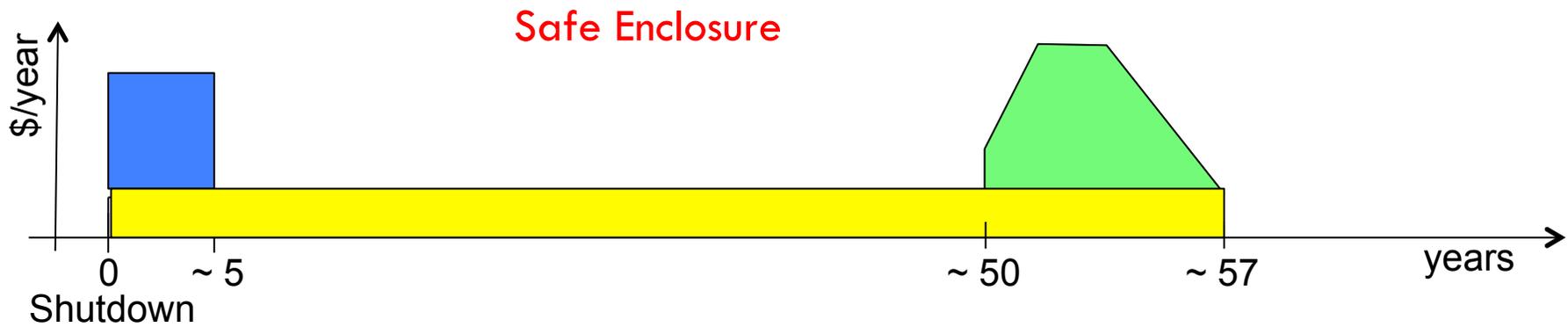
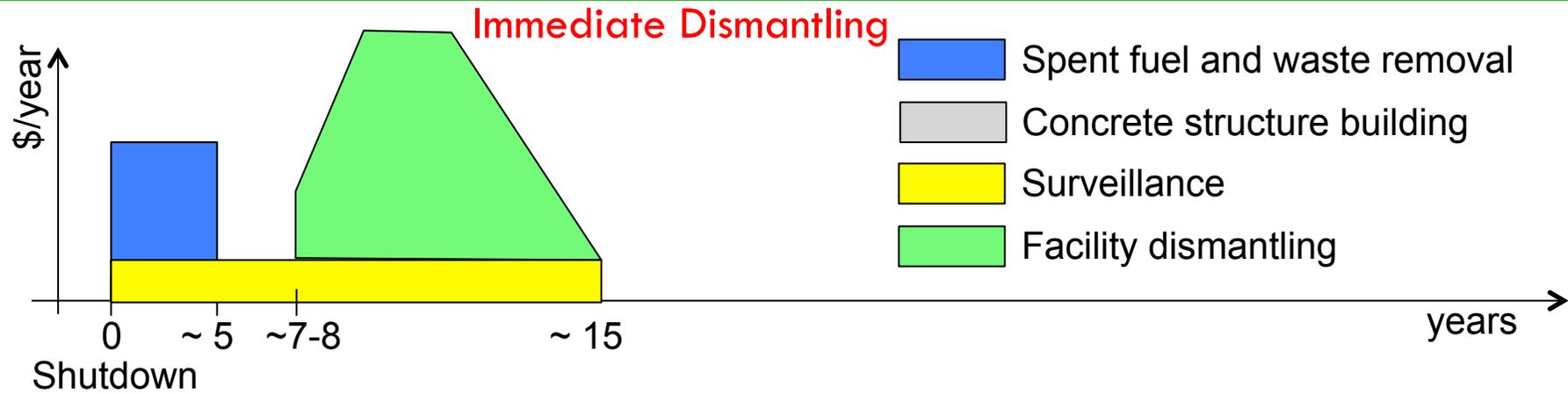
- ① **Immediate Dismantling**: responsibility for completion of decommissioning is not transferred to future generations. The experience and skills of operating staff can also be utilised during the decommissioning program.
- ② **Safe Enclosure**: allows significant reduction in residual radioactivity, thus reducing radiation hazard and costs of the dismantling.

In fact, about 99% of the radioactivity is associated with the fuel which is removed following permanent shutdown.

Apart from some surface contamination of plant, the remaining radioactivity comes from surface contamination and "activation products" in steel (vessel) which has long been exposed to neutron irradiation.

Stable atoms are changed into different isotopes such as Fe-55, Fe-59 and Zn-65. Several are highly radioactive, emitting gamma rays. However, their half life is such that after 50 years from closedown their radioactivity is much diminished and the occupational risk to workers largely gone.

# Costs of decommissioning



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The **total cost of decommissioning** is dependent on the **sequence and timing** of the various stages of the program.

**Deferment of a stage** normally tends to **reduce its direct cost**, due to decreasing radioactivity, but this may be easily **offset by increased surveillance costs**.

In most countries the operator or owner is responsible for the decommissioning costs.

Even allowing for uncertainties in cost estimates and applicable discount rates, **decommissioning contributes a small fraction of total nuclear electricity generation costs (~0.2 cEuro/kWh)**.

# Financing Methods

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Financing methods vary from country to country. The most common are:

- ① **Prepayment**: money is deposited in a separate account to cover decommissioning costs even before the plant begins operation.
- ② **External sinking fund**: this is built up over the years from a percentage of the electricity rates charged to consumers ( $\sim 0.2-0.3$  cEuro/kWh). Proceeds are placed in a trust fund outside the utility's control. This is the system most used in US and EU.
- ③ **Surety fund, letter of credit, or insurance** purchased by the utility to guarantee that decommissioning costs will be covered even if the utility defaults.

# Situation in Italy

- **Immediate Dismantling** was chosen as **Government strategy**;
- **Decommissioning funds** set aside by the plan owner were **not sufficient** to cover decommissioning costs, mainly due to early shutdown;
- **Decommissioning Costs** are charged over the years on a **dedicated component of the electricity bill**, under the control of the competent authority.

