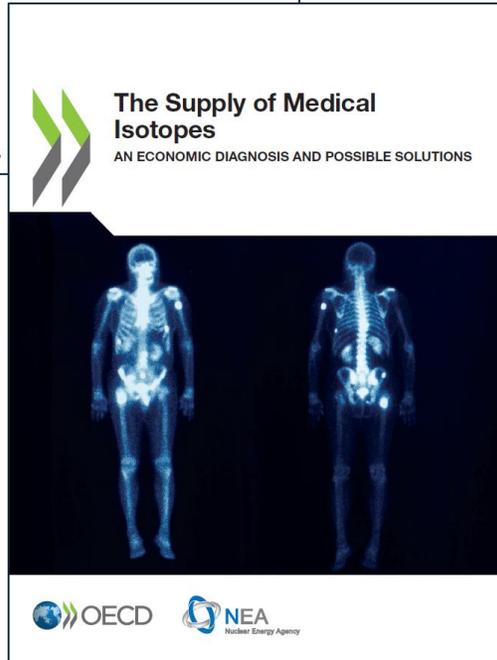
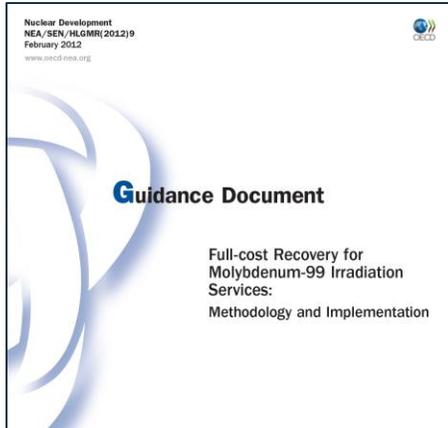


Full Cost Recovery (FCR) in the Market for Molybdenum-99

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Full Cost Recovery – Basics



According to recent NEA publications

Full Cost Recovery (FCR) in the market for molybdenum-99 (⁹⁹Mo) is the stated objective of NEA governments.

Full Costs correspond to the levelised unit costs of ⁹⁹Mo (LCUM), *i.e.*, the average discounted lifetime costs (including all capital costs) of ⁹⁹Mo production.

$$p_{99Mo} = LCUM = \frac{\sum (Capital\ Cost_t + Variable\ Cost_t) * (1 + r)^t}{\sum 99Mo\ doses_t * (1 + r)^t}$$

FCR is based on the desire to ensure the following objectives

- 1. Competition in the market for ⁹⁹Mo**
- 2. Security of supply for ⁹⁹Mo through ensuring adequate remuneration for all costs, including the costs of capacity**
- 3. Ensure some outage reserve capacity (ORC).**

NB: Data requirements for LCUM (a lifetime cost metric) are very high.

Full Cost Recovery – Added Facts

- Molybdenum-99 (^{99}Mo) has a half-life of 66 hours and its decay product used for medical diagnosis technetium-99m ($^{99\text{m}}\text{Tc}$) a half-life of 6 hours. **Both are non-storable goods!**
- Global market prices will thus equal the variable costs of the last (marginal) unit produced.
- During normal times (demand < capacity), prices will not include the capacity cost. This is independent of whether capacity receives capital cost subsidies or not. However:
 - Variable cost subsidies or price support make FCR even more difficult.
 - Capital cost subsidies affect the geographical distribution of production capacity.
- Prices may include capacity costs during periods of scarcity (demand > capacity). However, this means a supply crisis in which prices are *very* high and disruptions for customers *may* occur.
- In the absence of capacity mechanisms, markets for non-storable goods alternate between very low prices (demand < capacity) and very high prices (demand > capacity).
- **Unfortunately, no tendency in competitive markets towards *price = average costs = LCUM* and FCR.**
- **Absent a measure of capital cost support to ensure a coherent approach to reliable supplies, pure variable cost pricing carries the risk of periodic supply crises (certainly more frequent than today).**

OECD/NEA FCR Proposals in 2019

OECD/NEA proposed multiple options to enhance Mo-99 FCR methodologies in the Final Report of the Fourth Mandate of the High-level Group on the Security of Supply of Medical Radioisotopes (HLG-MR) in 2019:

- Phased and coordinated discontinuation of funding of NRR costs attributable to ^{99}Mo production by governments of producing countries;
- Increasing price transparency in the supply chain;
- Setting a temporary price floor for irradiation;
- Introducing a commodities trading platform for bulk ^{99}Mo ;
- Direct funding of Mo-99 production by end-user countries;
- Increasing use of substitute diagnostic imaging modalities or substitute isotopes;
- Move towards alternative methods to produce $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$

FCR Proposals Short of a Complete Solution

Unfortunately, none of the proposals solve the fundamental vulnerability that price equals variable costs in unregulated markets.

- Phased and coordinated discontinuation of funding of NRR costs attributable to ^{99}Mo production by governments of producing countries – **phasing capital cost subsidies would achieve $p = LUCM$ and FCR only at the cost of repeated supply crises; variable cost subsidies and price support should be discontinued immediately instead.**
- Increasing price transparency in the supply chain – **valiant but impractical; cost structures (many legacy costs depending on discount rate assumptions) are difficult to establish;**
- Setting a temporary price floor for irradiation – **this would end price competition; depending on the level, it could encourage new entrants and oversupply;**
- Introducing a commodities trading platform for bulk ^{99}Mo – **why not? But if efficiency gains were real, private brokers would already have moved into this space;**
- Direct funding of Mo-99 production by end-user countries – **this would amount to nationalisation with certain efficiency losses; if private, no difference; might save on transport costs;**
- Increasing use of substitute diagnostic imaging modalities or substitute isotopes – **would depend on the costs and economic characteristics of substitutes; at current knowledge, would lead to cost increases;**
- Move towards alternative methods to produce $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ – **no difference, $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ would still be a non-storable goods with all connected issues.**

For Discussion – A Way Forward

The original objectives of the HLG-MR remain valid and worth pursuing:

1. Price competition in the market for ⁹⁹Mo
2. Security of supply for ⁹⁹Mo through ensuring adequate remuneration for all costs, including the costs of capacity
3. Ensure some outage reserve capacity (ORC).

➤ Electricity markets could provide a roadmap for successful capacity management in the form of **capacity remuneration mechanisms (CRM)** or **capacity payments** consisting of the following elements:

- a) Processors compete on price. Thus $p = \text{variable cost}$ or slightly above due to transport costs and frictions.
- b) NEA countries agree to levy a capacity contribution to be paid by customers on each dose of ⁹⁹Mo sold.
- c) Revenues would be distributed to processors *pro rata* for their *available capacity*;
 - i. Participants in CRM need to be qualified *ex-ante* (either through inspection or a minimum number of operating days per year);
 - ii. Participating processors would also need to prove that they do not receive additional subsidies;
 - iii. The level of levy and support through CRM would vary whether existing capacity is deemed sufficient or new capacity is required;
 - iv. A competitive reverse auction for CRM support would ensure efficiency and value for money.

This measure could achieve Full Cost Pricing (FCR) by combining variable cost pricing with optimized capacity support.



**Thank you for
your attention**