WE ARE INNOVATION

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THE REACTOR IN THE ROOM

Civilian Nuclear Power as an Underused Engine for Medical Isotope Security

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Executive Summary

Every year doctors order around thirty million scans and treatments that hinge on medical isotopes, faintly radioactive substances that either highlight disease under a scanner or carry a dose of radiation straight into a tumor. And almost no one outside of nuclear-medicine departments knows how scarce the supply really is.

Take for example the single most-used diagnostic isotope: it upholds roughly 85% of all nuclear-medicine scans, and nearly all of the worldwide supply traces back to seven nuclear research reactors. Six of those were built at least fifty years ago, initially intended as scientific research centers during the Cold War, and only subsequently converted into global medical lifelines. Today, they are the weak point in the whole system, each one of them a mechanical fault or a budget cut away from going dark.

When one of them stops, hospitals feel it within days. It is impossible to stockpile the product, as it decays within hours, so there is no reserve to fall back on. During the 2009–2010 shortage, world supply fell by as much as 70%: scans were rationed and some patients ended up in surgery instead of getting a diagnostic test for no reason except that the material wasn't there. It happened again in late 2024, when a Dutch reactor went down for repairs while others were closed for maintenance, and part of the world was left without this fundamental tool once again.

The most frustrating part of this is the economic reasons why this keeps happening: the producing reactors were run by governments, who sold the isotopes below what they actually cost. This went on for decades. On a surface level, this looks incredibly generous, but the reality is that this only serves at keeping private capital out: no company could build modern capacity while competing against subsidized, state-backed reactors selling at a loss. So nobody built, and the world stayed tied to the old machines.

What makes this worth writing about now is that Canada has shown the alternative works: its commercial CANDU power reactors, the ones already feeding electricity to the grid, can be refueled and loaded with isotope targets without ever shutting down, producing cancer medicine and electricity at the same time. Bruce Power was the first operator anywhere to produce a major therapy isotope inside a working power reactor; this way, Ontario's Darlington station became the first commercial plant licensed to make the key diagnostic isotope. To put it into another perspective: our dependence on a handful of aging research reactors is something we chose. It can be un-chosen.

Now more than ever, timing matters. A new generation of cancer therapy is now running straight into the supply problem. These treatments pair a "scan" isotope that finds the cancer with a "strike" isotope that kills it; some of them are already approved in the US and Europe and are extending the lives of patients who had previously run out of options. The most promising versions rely on *actinium-225*, which is so scarce that the entire world's annual output can treat fewer than a hundred people. In 2024 a late-stage trial was paused for lack of it: the drug hadn't failed. The supply simply did not exist.

This paper will be discussing how the answer to this problem is smarter regulation rather than less of it. About a decade ago most of the world's diagnostic isotopes were made from weapons-grade uranium, and a well-designed law phased that out without costing patients a single dose. That is the model. It applies to every bottleneck still in the way.

Introduction

As medical research progresses, the focus of physicians all around the world is gradually shifting towards therapy catered to the individual case rather than the broad pathology. In oncology, this translated to a rise in the use of radioactive isotopes that are flexible enough to both convey medicine and locate cancer cells during scans. The production of these isotopes relies on the same mechanisms that sit behind nuclear energy, both in infrastructure and method alike. Deep inside the nuclear power plant core, fission releases a dense flux of neutrons, and a target material placed in that flux changes under it: some atoms absorb a neutron and transmute into a radioactive form, while a uranium target undergoes its own fission and yields the isotope among its fragments, resulting in a chemically purified substance that can be bound to a carrier molecule to release the therapeutic isotope close to the target.

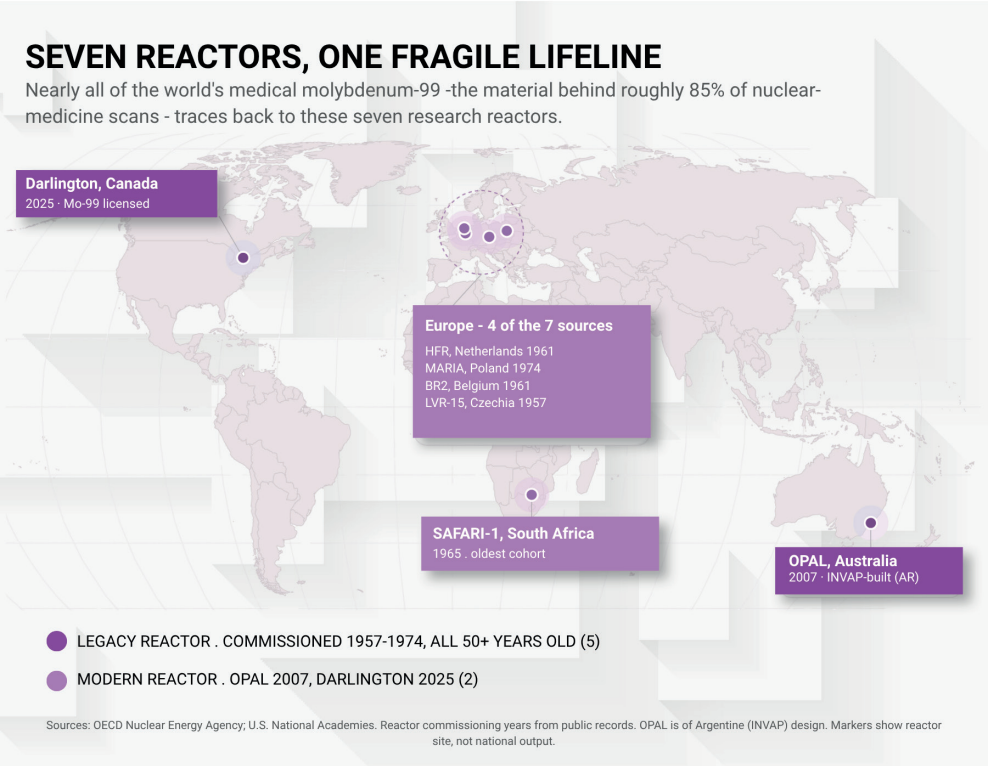
In this paper, we will be addressing the main issue behind the supply chain: the incredibly scarce and outdated apparatus that supplies the world's demand for radioisotopes for oncology treatments.

A Supply Chain Built on Borrowed Time

Let's start with an explanation of what a medical isotope actually is: it is a specially made, slightly radioactive, version of an ordinary atom. It gets attached to a molecule built to travel to a specific place in the body, maybe a particular organ or even a kind of tumor, and then physics does the rest. As for diagnostic isotopes, they work like a tracer, gathering where the disease is and showing up on the scanner. A therapeutic isotope is closer to a delivered dose of radiation, riding the same kind of targeting molecule, that then hits the tumor at close range and leaves most of the surrounding tissue alone.

This is not fringe technology: technetium-99m is the main diagnostic isotope nowadays, and is used in about 85% of nuclear-medicine scans, which equals roughly thirty million procedures a year, more than forty thousand a day in the United States alone. Cardiac stress tests, cancer staging, bone scans, pediatric kidney studies. A huge share of them depend on a vial of material that did not exist a week earlier and will be useless a week later.

Nearly the entire world supply of that isotope comes from only seven research reactors located in Belgium, the Netherlands, Czechia, Poland, South Africa, Australia, and, as a recent addition, Canada. Almost all of these reactors are more than fifty years old, built for research purposes during the Cold War; the exceptions are Canada's newcomer and Australia's OPAL, which — in a detail worth holding onto — was designed and built by Argentina's INVAP. Machines of that vintage cannot sustain the steady medical production required, and on top of that, they mostly run for about two-thirds of the year. The OECD's Nuclear Energy Agency has been silently observing the reliability of this arrangement slowly decreasing in the span of this last decade, as those few old machines go down more and more often and for longer and longer periods of time.



Moreover, the isotopes produced cannot be stored, which is what turns fragility into crisis. Picture a dose as an ice cube ordered for urgent delivery, with no freezer anywhere along the way: it starts melting the moment it is made. Molybdenum-99, the primary isotope used in diagnostic medicine, loses about 1% of its strength every hour, so by the time it reaches a hospital, roughly half is already unusable. The Technetium drawn from it fades faster, around 10% an hour. The current way of solving this problem is selling the material as "six-day curies" where the dose contained is guaranteed to stay viable for those six days. This means that even a single delayed flight or a customs hold, and our ice cube arrives as water. There is no warehouse to draw on. Every dose delivered is a race against decay.

When that race is lost the consequences are tangible. During the 2009–2010 crisis, supply hit its lowest point at 70% below demand; scans were rationed and postponed, and the agency's own leadership reported of patients who could not be diagnosed at all, or who were pushed toward more invasive options including surgery, because of the unavailability of isotopes. The lesson was not learnt: in late 2024, the Dutch reactor at Petten went offline for a deformed pipe just as reactors in Poland and Belgium were down for planned maintenance, and that overlap alone cut supply by half or more across whole regions of the world. A system this concentrated doesn't degrade gracefully: when it breaks, whole regions lose supply altogether.

Yet the map of this fragile system contains one anomaly worth pausing on: Argentina. The country's current share of global molybdenum-99 production is modest, but its footprint in isotope security is considerably larger than that number suggests. A materially bigger slice of world supply flows through reactors of Argentine design, OPAL among them, one of the youngest and most dependable machines in the fleet. And Argentina was among the first countries to convert its Mo-99 production entirely to low-enriched uranium targets, anticipating by two decades the non-proliferation standard the market now demands of everyone else.

That quiet record is about to change scale. The RA-10 multipurpose reactor, now in the final stages of commissioning and expected to reach first criticality in early 2027, comes paired with a radioisotope production facility, under development, that would give Argentina the capacity to supply on the order of 18–20% of global Mo-99 demand by the end of the decade, together with therapeutic isotopes such as lutetium-177 and iridium-192. Just as important is what else the reactor will do: neutron transmutation doping of silicon for the power-electronics supply chain, precisely the diversified revenue base that makes isotope production economically sustainable rather than structurally subsidized, the quiet weakness that has hollowed out the incumbent fleet. In a market defined by aging reactors and chronic supply fragility, Argentina offers what isotope security actually requires: proven technology, a complete fuel cycle under safeguards, and Western-aligned reliability.

Why a Market-Based Model Is Needed

The oddest thing about this predicament is that it was caused by good intentions: for decades the research reactors that produced the whole world's Molybdenum-99 were government machines, initially built and funded for science, where these isotopes were treated as a useful by-product to be sold off cheaply. It surely looked like a bargain: what hospitals paid never came close to what the real cost of running, and eventually replacing, a reactor. We now know that the bill would have to be paid somehow.

Cheap subsidized supply did here what it tends to do anywhere else: it drove out everyone who would have had to charge a realistic price. No private firm could justify building modern, reliable capacity while competing against a state-backed reactor selling below cost, so nobody built them. When OECD's nuclear agency studied the supply chain in detail, it concluded that the best course of action should be charging what the medicine actually costs to produce, reactors included. The consequence is obvious: investments become rational, modern facilities become bankable, and the economics of reliability start to work. They paired this with a second idea, borrowed from the most resilient industries: paying producers to keep spare capacity in reserve, enough to cover the loss of the single largest source. It is the "spare tire in the trunk" You pay something extra just to be able to carry it around, hoping to never need it, but the day you do need it, that's what makes a difference between disaster and success. A market that won't pay for the "spare tire" seems to be cheaper, more efficient in managing resources and maybe even feels like it has the interest of many in mind, but it's just jeopardizing the patient's life.

The usual objection here is that the demand for these isotopes is so essential that price can't condition it, and therefore hospitals will pay whatever they are asked to. The evidence, however, proved that when shortages pushed prices up, it was the providers that adapted, by stretching each generator further, rescheduling non-urgent scans and switching to alternative isotopes wherever they could. There is no fundamental difference between normal market behaviour and how it works in this field, but by not allowing it to operate, it became clear how the subsidized model is the main cause of this inefficiency. These hypotheses became a consolidated fact when the shut down of a US producer's Molybdenum operations highlighted the inability to compete with cheaper subsidized foreign productions.

The Canadian Commercial Power-Reactor Model

The fix turns out to be hiding in plain sight, already wired into the grid on the shores of the Great Lakes: Canada has taken the power stations that keep its cities lit and turned them into producers of cancer medicine, doing both jobs at once, without

ever switching off.

It all comes down to how the machines are built. Canada's CANDU reactors can be refueled while running, and isotope targets can be slipped in and pulled out without ever shutting the reactor down, while a conventional research reactor making isotopes is a single-purpose instrument, is very expensive to run and stays idle for much of the year. A CANDU is a commercial plant earning its keep by selling electricity around the clock, with isotope production riding on top of infrastructure that already pays for itself; that is the whole appeal: a second use for something that already exists, and a place where the economics finally line up.

Bruce Power demonstrated how this could work in 2022. Working with a coalition of partners and the Saugeen Ojibway Nation, the operator installed a production system inside one of its reactors and made the world's first Lutetium-177, a potent cancer-therapy isotope, inside a commercial power reactor that kept generating electricity the entire time. The company's development chief, James Scongack, called it a demonstration that CANDU reactors could deliver large-scale, reliable production of critical medical isotopes. Two years on, and the partners reported they hadn't missed a single shipment since launch, had doubled capacity with a second production line, and were preparing a second reactor unit to take over when the first goes offline for scheduled maintenance, the kind of redundancy the old system never had.

Another revolution happened not very far from there: the Darlington station, located east of Toronto, instead chose to tackle diagnostic shortage directly. Thanks to Ontario Power Generation's commercial arm, Laurentis Energy Partners and its partner BWXT Medical, Darlington became the first commercial power reactor licensed to produce Molybdenum-99, the isotope behind those thirty million annual scans. It does this with ordinary Molybdenum targets rather than the uranium targets research reactors had always traditionally used, which avoids a whole set of waste and security problems at the same time. The strategic advantage is hard to miss: Canada's old NRU reactor once produced around 40% of the world's Molybdenum-99 before it shut down in 2018 after a long service life; when it closed, North American hospitals were left importing every dose from Europe, Africa and Australia. With Darlington's reactor entering the scene, North America now has the power to get back all of its self-sufficiency.

Innovation doesn't end there. In 2025, regulators cleared Laurentis to begin producing the therapy isotopes *Lutetium-177* and *Yttrium-90* at Darlington, using what the company calls "the single largest isotope-production system in North America". Laurentis confidently claimed that the facility could eventually make enough *Lutetium-177* to supply close to three million doses a year; "enough" the company stated, "to treat half a million patients". Those are the operator's projections, not yet independently verified, and they depend on regulatory approvals and commercial milestones still ahead.

None of this is entirely new, either. Canadian CANDU reactors have produced Cobalt-60 for decades: we're talking about the isotope that sterilizes much of the world's single-use medical equipment and feeds the Gamma Knife systems used on brain tumors, supplying roughly half the globe, with a Bruce Power agreement now securing it through 2064. The dual-use model has been quietly working for years, and Canada just confirmed that it can be scaled up to supply the medicines that matter the most.

Theranostics, Alpha Therapy, and the Actinium-225 Bottleneck

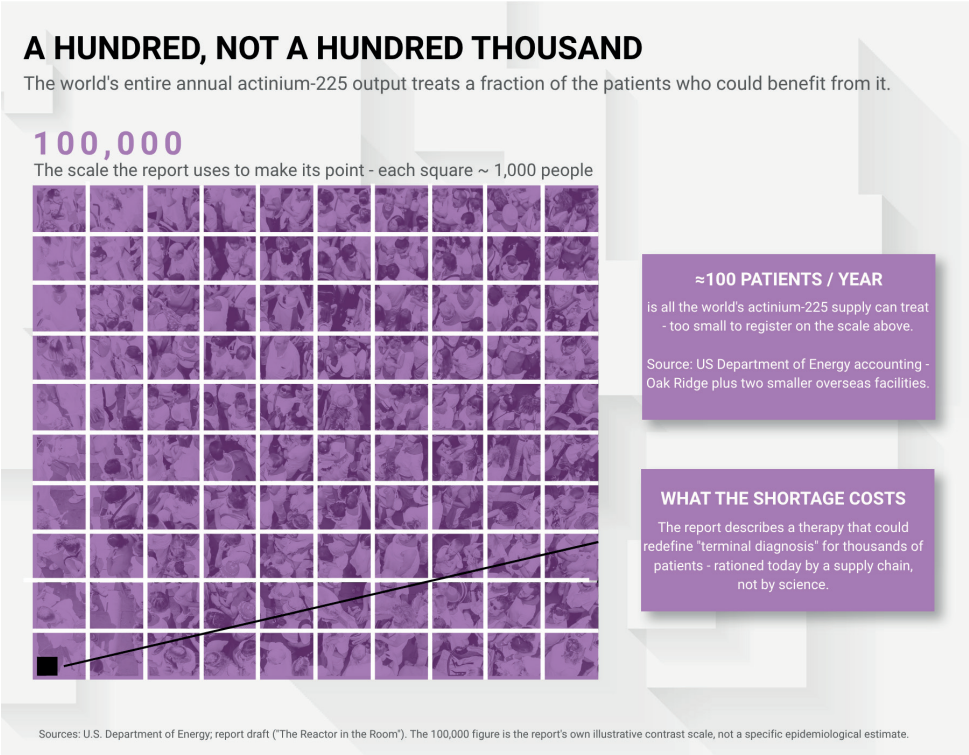
For the most part of the history of medicine, cancer treatment has been imprecise: chemotherapy drugs act as poison for all fast-dividing cells throughout the body, both cancerous and healthy alike, and radiotherapy works by burning a path through tissue to reach the tumor underneath it. Theranostics is an attempt to get out of that trade-off. The idea behind it is very straightforward: you start by taking a molecule that cancer cells will actively assimilate, like a key cut to only fit their specific lock, and attach a faint radioactive tracer to it. As you inject the patient with it, cancer cells show up on the scan and this gives you a clear target to aim for. You then swap the tracer for a payload: the same molecule, headed for the same target, now carries an isotope that delivers a lethal dose of radiation on contact.

This is definitely the most thrilling part.It is an argument very rarely discussed during medical school lectures, so many students will never discover the potential behind this innovative subject. Lectures revolve around cellular mechanism (ligand-receptor interactions, the effect of radiation on DNA), but almost nothing is taught about how these isotopes are produced or how fragile they are. Yet that facility is clinical: a patient might not get nthe care they need because of a failure

during transportation.. It just goes to show how little importance is given to the development of this particular branch of medicine.

Luckily, things might be taking a turn for the better. *Lutetium-177*-based therapies are already approved by the FDA and European regulators, specifically for a rare and difficult subtype of neuroendocrine tumors, and another for advanced prostate cancer resistant to traditional therapy. Let's look at the findings for the prostate cancer trial: patients who were given the new therapy alongside standard care lived meaningfully longer than those that were kept on standard care alone, and it has since been approved for use much earlier in the progression of the disease.

Even so, the most powerful version of radiology therapy uses a much more scarce type of radiation. While *Lutetium-177* emits beta particles, this unique approach uses targeted alpha therapy, with isotopes that emit alpha particles, which are far heavier and far more destructive while still being incredibly precise in targeting even small clumps of cancerous cells. The leading candidate is *Actinium-225*, and oncologists all over the globe talk about its potential in unusually strong terms. Sadly, as we must have surely learnt by this point, things are not so simple as it seems.



There is almost no *Actinium-225* available worldwide: it doesn't naturally occur in usable amounts, and for decades the only meaningful source was a Cold War leftover, a stockpile of *Thorium-229* located in Oak Ridge, itself a relic of America's Uranium-233 programs, that's slowly being milked for the trickle of Actinium it gives off. Let's take a look at these almost unbelievable numbers: according to the US Department of Energy's own accounting, Oak Ridge plus two smaller facilities abroad, has produced enough Actinium-225 to treat fewer than a hundred patients a year. Not a hundred thousand. A hundred. A treatment that could change the meaning of "terminal diagnosis" for thousands of patients only exists in quantities you could practically cup in your hands, only held back by the lack of facilities that could produce it.

That equation became impossible to ignore in 2024, when a late-stage clinical trial (the kind that stands between an experimental therapy and FDA-approved drugs) was paused for lack of Actinium-225. The drug had worked well enough to reach Phase 3. Patients were enrolled. And the trial stopped anyway, because there wasn't enough of the crucial substance needed, as nobody had bothered to manufacture at scale. Once again, the critical lack of infrastructure is getting in the way of revolutionizing the world of chemotherapy.

That work is now, belatedly, getting done, and it is going towards further developing the nuclear industry. Private firms are attacking the bottleneck from several directions at once: extracting far more Thorium from the Oak Ridge stock than was ever managed before, building generators that let drug companies produce Actinium on-site, and developing reactor and

accelerator routes that make it from scratch rather than waiting for it to drip out of a decades-old supply. New joint ventures and production lines have come to life within a couple of years, and several of the largest pharmaceutical companies have started paying billions to lock up isotope supply, a fairly clear sign that they now treat it as the strategic chokepoint it has been all along.

Small Modular Reactors and Decentralization

Every argument made so far faced the same weakness: there is not enough implant concentration. A few reactors, one legacy stockpile, a supply chain with too few origins and no slack allowed. The obvious answer to a concentration problem is to spread the production out, and that is the promise of the small modular reactor (SMR).

We could roughly compare SMRs to a laptop, while the well-known classic reactor is a desktop. Instead of one enormous reactor built over a decade for billions of dollars on a single site, an SMR is a fraction of the size, small enough to be assembled in a factory and shipped to where it is needed: lower cost, lower risk, faster to build, and many of them rather than one. For electricity production, that means a grid that can grow in increments and reach places a large plant could never.

The comparison is not perfect, of course. A laptop can be carried anywhere and switched on by anyone, while a reactor, however small, still requires licensing, a security perimeter, and trained operators. What actually transfers from the analogy is the architecture: modularity means each unit is built to the same standardized design in a controlled factory setting, rather than engineered from scratch on-site, which is where most of the cost overruns and multi-year delays of conventional reactors originate. Factory fabrication also allows serial production and iterative quality control, the same logic that made electronics cheap and reliable. And because output scales by adding units rather than enlarging a single core, capacity can be matched to regional demand and expanded incrementally, without the enormous upfront capital commitment that a gigawatt-scale plant locks in from day one.

As for the medical field, it points somewhere even more interesting: isotope production scattered across dozens of local sites instead of locked inside seven irreplaceable machines, each site serving its own region. Lose one reactor in that arrangement and you only lose a sliver of capacity, instead of a quarter of the world's supply.

Having proven the dual-use model with its larger reactors, Canada is now building the flagship of the smaller version. Ontario Power Generation's project at Darlington received its construction license in 2025, the first grid-scale SMR approved in Canada and a first of its kind for the Western world, with the first unit expected to deliver power by the end of the decade. Evidence that this technology is efficient and realistically fundable, and finally moving from proposal to construction.

It is worth analyzing the gap between promise and reality critically, though. No operating SMR anywhere makes medical isotopes at scale as of today: the Darlington SMR has no confirmed mandate to produce them, and the developers talking up decentralized isotope hubs are describing business plans, not running production lines. The distributed medical grid is a future to build toward, rather than a capability that exists now; right now, all the work is being shouldered by the technology already in use, like the large CANDU power reactors making Lutetium, Molybdenum and Cobalt without ever taking a break. With this Canadian success and the promise of rising star SMR, the optimization of the production of cancer-medicine is now an incredible and tangible prospect for the next decade.

Logistics, Transport, and the Race Against the Clock

Let's go back to the decay problem. We understood that every diagnostic dose leaves the reactor facility already losing its strength, and nothing in the chain can slow that down. The product is dying from the moment it is made, and the only real question is how much of it survives the trip to get to the patient.

The logistics behind a correct transportation method then become an important risk to consider during the production of said isotopes. A perfectly run reactor's output can still be lost to a delayed truck or a held shipment, as the producing reactors only sit in a handful of countries and most isotopes have to cross borders to reach the people who need them. This leaves them at the mercy of customs queues, paperwork, and the schedules of commercial aviation, and we saw just how easily this workchain becomes in the moment the world stopped flying altogether: before the pandemic, a large share of global air

cargo travelled in the holds of passenger jets, and when those fleets were grounded in 2020, isotope shipments were thrown into disarray, and supply lines built on the assumption of constant flights had to be improvised overnight.

When a PET scan is postponed because the tracer failed to arrive from the radiopharmacy that morning, it reads on the ward as ordinary bad luck, a scheduling hiccup easily solved by moving the patient next week. With everything covered so far, the same event looks different. That delay was not a medical failure at all: it was rather the visible end of a supply chain that ties back to a handful of state-subsidized reactors, most of them older than the physicians reading the scan, and the patient in front of you simply suffers from the slack the system was never built around of. Not only that, but the friction caused by international delays and controls keeps rising: Europe's own isotope specialists working through the EU's SECURE programme flagged that Brexit alone added new export-control hurdles for radioactive shipments, with more forms, more checks, more hours added to a journey already being measured against half-life.

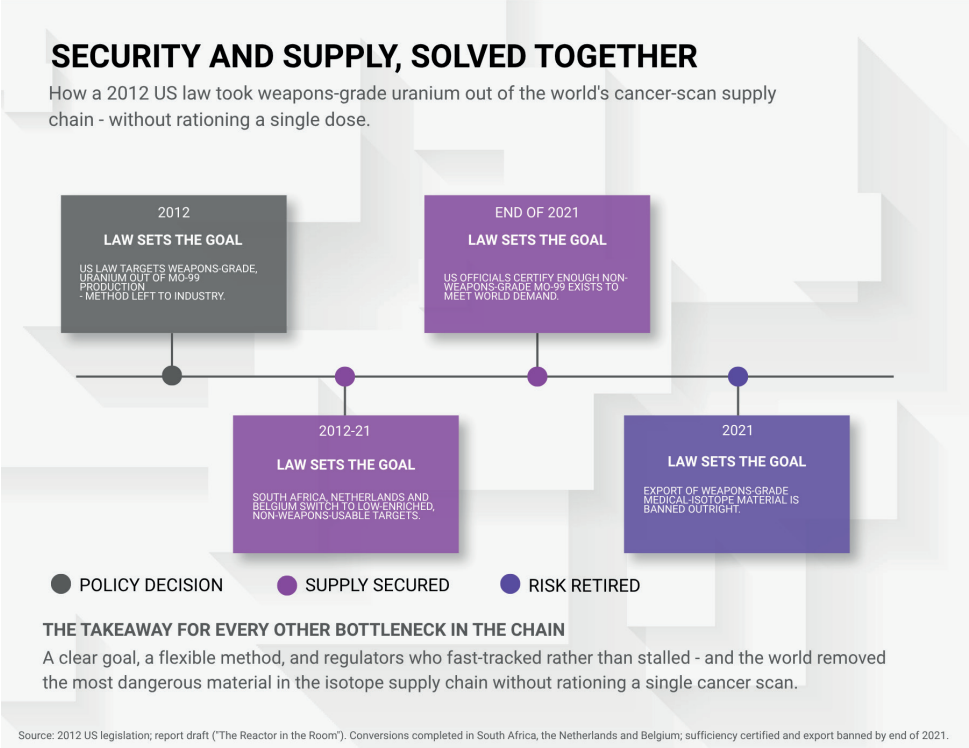
There is really only one durable way to beat a clock that keeps ticking, and it is to shorten the distance the dose has to travel: a supply chain spread thin across a few intercontinental sources will always be racing decay across oceans, but regional reactors and local production change the math, as doses travel hours rather than days, and less of each batch is lost on the way.

Smart Regulation: The Proof That We Can Have Both

A little over a decade ago, a genuinely alarming feature was buried in the isotope supply chain. Most of the world's *molybdenum-99* was made using highly enriched uranium, the same weapons-grade material that nonproliferation experts spend their careers trying to keep contained. The medicine used to find cancers was being made from bomb-grade fuel.

The reason came down to chemistry and yield. Producing *molybdenum-99* means irradiating a uranium target in a reactor and then extracting the isotope from the fission products, and for decades the targets that gave the ebay yield were made fom uranium enriched to weapon grade, above ninety percent of *uranium-235.* The more enriched the target, the more molybdenum per gram and the less waste to handle, so the medical supply chain quietly standardized on exactly the material that arms-control regimes were built to lock away

The instinctive policy response could easily have been the worst one; clamp down, restrict, treat the whole field as too dangerous to expand, and let the supply of cancer diagnostics shrink in the name of safety. Fortunately, that is not what happened.



In 2012, the United States passed a law that did something surprisingly effective. The law set a clear goal, to get weapons-grade uranium out of the medical supply chain, and then declined to dictate the method, leaving industry to find the best technical route: this way, regulators committed to fast-tracking the new approaches rather than slowing them down, and governments shared the first-of-a-kind risk. The producers delivered immediately: the facilities in South Africa, the Netherlands and Belgium converted to low-enriched, non-weapons-usable targets, and by the end of 2021 US officials certified that the world made enough non-weapons-grade Molybdenum to meet demand, and the export of the dangerous material was banned. The experts had been right all along: there was no technical reason the medicine needed the bomb-grade ingredient.

We observed in real time what good regulation looks like: the world took the most frightening element of the isotope supply chain, material that could in principle be diverted to a weapon, and removed it without losing the medicine. Security and supply improved together, thanks to rules created with a clear purpose and a flexible means and then applied without letting caution curdle into paralysis. If the world could solve the weapons-grade uranium problem without rationing cancer scans, then the smaller obstacles now slowing this field (like licensing regimes that never imagined a power reactor making medicine, or the creation of laws that treat a decaying dose like ordinary cargo, or even the absence of a payment model that rewards reliability) are not inflexible facts either. They are old rules that haven't caught up to what is now possible, written for a world of single-purpose research reactors and weapons-grade targets, and that world is finally coming to an end.

A Roadmap for Policymakers

The technology already works, the economics are understood, and there is at least one clear case of a country getting it right. What remains is largely a matter of coordination. That is a less dramatic conclusion than a call for breakthrough innovation, but it is also a more tractable one: the hard work has already been done elsewhere, and the task now is to replicate it well. A roadmap is more credible when it acknowledges where the friction lies, so the constraints are named directly in what follows rather than left implicit.

Regulators can treat isotope production inside a commercial power reactor as licensable critical infrastructure, and they don't even have to figure out the groundwork, because Canada already did; its regulator licensed Bruce Power and Darlington to make medicine inside working power plants, and that approval process exists, on paper, ready to be borrowed. The US Nuclear Regulatory Commission and the national authorities across Euratom could take inspiration from that template and build a standard, faster pathway on top of it, so the next operator who wants to step in can simply follow a route that's already been paved. One thing is worth carrying over from the Uranium story: when there's a choice of method, lean toward the low-enriched and natural-Molybdenum routes Darlington uses, so that growing the supply and keeping it secure moves together instead of pulling against each other. A good early target? One commercial power reactor outside Canada licensed for this within a few years, small and easy to check.

As for the OECD's recommendation, it honestly isn't that complicated: the suggestion is to pay what the medicine actually costs to make, and pay producers a little extra to keep some spare capacity in reserve for the day the biggest supplier goes down. The USA will be the first to apply this recommendation, as from 2026 they'll add an extra payment for Molybdenum produced at home. Our suggestion is to make it permanent: extend the same idea to the therapy isotopes and the investment case that's been missing for decades suddenly starts to add up on its own. There's a reason not to drag this out, too. The old reactors can only be retired gently once something reliable is ready to take their place, so paying for reliability now is really just paying for a handover that doesn't end in a shortage.

Logistics is the next piece, and it's the one that quietly wastes the majority of the hard earned production. Give medical isotopes priority-cargo status with customs cleared in advance, and you win back hours that currently vanish into forms and queues; set up standing backup freight, and the next time passenger flights get grounded, a whole region isn't left waiting on an empty runway. The post-Brexit export friction that European specialists keep flagging is exactly the sort of thing a focused agreement on fast radioisotope transit could mostly solve. None of this is glamorous, but every hour saved in transit is a dose that reaches a patient instead of decaying on a loading dock.

That leaves the frontier, where the right mood to adopt is patience with a little optimism stirred in. The approach that fixed the uranium problem, a clear goal set by the government, can be aimed squarely at the *actinium-225* shortage and at the reactors still to come. I'd suggest being careful here, though. Small modular reactors haven't actually made these medicines at scale yet, and the big capacity numbers coming out of Canada are still projections, resting on approvals nobody has yet

granted. So, back the evidence, and not the hype. Ask new reactor designs to assess their isotope potential, let the proven large reactors and the accelerators carry the load while the small ones grow up, and be ready to invest money into whatever turns out to actually deliver. This way, in twenty years we will have built a strong foundation for the future of nuclear medicine.

Conclusion: Unleash the Atom That Heals

Strip away the chemistry and the acronyms and what is left is a genuinely encouraging story. Science works. The reactors that can make these medicines at scale are not speculative; they are running on the shores of the Great Lakes right now, selling electricity and producing cancer treatments in the same shift. The therapies are real, approved, and already extending lives that medicine had given up on. The security problem that should have been the great obstacle was solved years ago, cleanly, without costing a single patient a dose. Every hard problem in this field has, at some point, turned out to be solvable.

What this tells us is that the remaining obstacles, old licensing frameworks, misaligned pricing, customs rules that were never written with a decaying medicine in mind, are not walls. They are doors that have not been opened yet. Canada opened one, and showed the world what was behind it. The economic logic is understood. The regulatory template exists. The clinical need is not in question.

There is real momentum here, and it is pointing in the right direction. Commercial nuclear power has quietly become one of the most life-saving industries on earth, and it is only beginning to show what it can do for medicine. The pieces are on the table, the direction is clear, and the distance between where we are and where we could be is shorter than it has ever been.

About the Author

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