

Elements on Demand

What the Vacuum.Net Theory Says About Making, Rather Than Recycling, Critical Raw Materials

J. Konstapel, Leiden, 9 October 2026

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1. The occasion

On 9 October 2026 the European Commission named 46 new strategic projects under the Critical Raw Materials Act. Four are Dutch. All four recycle: copper (3ECYCLE, Mitsubishi Metals), bauxite, aluminium and copper (Myne, Harderwijk), batteries (Back to Battery, The Hague) and printed circuit boards (CRITICAL, Rotterdam).

The targets for 2030 are 10% own extraction, 40% own processing and 25% recycling, for seventeen materials. The 46 projects need €21.1 billion. The earlier round of 47 projects has raised €2 billion so far. No mine has opened in the Union for ten years.

All three targets treat an element as a stock. It lies in the ground, in a factory or in a discarded phone. It can be dug, refined or recovered. It cannot be made.

This essay asks whether that last sentence holds. It uses the Vacuum.Net theory to state the question. It then sets the measured record beside it.

2. The net

The picture is a fishnet stretched in water. Strands run everywhere, under tension. Where strands wind around each other, knots appear. Between strands lie meshes: openings with a shape and a size. A winding persists only if it returns in phase inside its mesh.

Four words carry the theory.

- **Strand.** The net itself.
- **Winding.** A strand closed on itself. This is what physics calls energy.
- **Knot.** Windings that hold each other in three directions. This is what physics calls mass.
- **Mesh.** The opening between strands.

Dewey Larson wrote the same ladder in 1959 as powers of one ratio, space over time. Speed is S/T . Energy is T/S . Mass is T^3/S^3 .

An element, on this ground, is a knot. The question of making an element is the question of what fixes which knot closes.

3. An element has two numbers

Larson gives the mass of an element as two parts. The first is rotational: two units for each unit of atomic number Z . The second is vibrational. It depends on the state of the surroundings, which Larson calls the magnetic ionization level, I .

$$A = 2Z + I \cdot Z^2 / 156.444$$

The number 156.444 is Larson's inter-regional ratio. On Earth, $I = 1$.

So an element carries two numbers. Z is its address. I is the state of the net around it. The address belongs to the knot. The state does not.

The rule can be checked by hand for the materials on the European list. Take copper, $Z = 29$. The rotational part is $2 \times 29 = 58$. The vibrational part is $29^2 / 156.444 = 841 / 156.444 = 5.38$. The sum is 63.38. The measured value is 63.55.

Element	Z	2Z	$Z^2 / 156.444$	Computed	Measured	Difference
Lithium	3	6	0.06	6.06	6.94	-12.7%
Aluminium	13	26	1.08	27.08	26.98	+0.4%
Silicon	14	28	1.25	29.25	28.09	+4.1%
Cobalt	27	54	4.66	58.66	58.93	-0.5%
Nickel	28	56	5.01	61.01	58.69	+4.0%
Copper	29	58	5.38	63.38	63.55	-0.3%
Germanium	32	64	6.55	70.55	72.63	-2.9%
Neodymium	60	120	23.01	143.01	144.24	-0.9%
Dysprosium	66	132	27.84	159.84	162.50	-1.6%
Tungsten	74	148	35.00	183.00	183.84	-0.5%
Lead	82	164	42.98	206.98	207.20	-0.1%

Seven of eleven fall within 1%, or close to it. Lithium, silicon, nickel and germanium do not. The rule is a first-order description, not a table of isotopes.

4. Three operations on a knot

The net allows three things to happen to a knot.

Rearranging. The knots stay closed. Only their places change. This is chemistry and metallurgy. It is what the four Dutch projects do. A typical step costs of the order of 10^5 joule per mole.

Opening. A knot loses one closure and steps down the ladder, from T^3/S^3 to T/S . The factor between the two rungs is T^2/S^2 , which is c^2 . One full mass unit is $1.6605 \times 10^{-27} \text{ kg} \times (2.998 \times 10^8 \text{ m/s})^2 = 1.49 \times 10^{-10} \text{ J}$. For one mole that is $9.0 \times 10^{13} \text{ J}$.

Raising. A knot takes on closure and moves one address up.

The second and third operations change the element. Both depend on the second number, the state.

5. The state moves the limit

Larson sets a limit at 236 mass units. A knot above it must shed mass. The limit follows from the rule in Section 3.

At $I = 1$, element 91 gives $182 + 8281/156.444 = 234.9$. Element 92 gives $184 + 8464/156.444 = 238.1$. Uranium is the first knot above the line. It opens, slowly.

At $I = 2$ the vibrational part doubles. Element 78 gives $156 + 77.8 = 233.8$. Element 79 gives $158 + 79.8 = 237.8$. Gold is the first knot above the line.

At $I = 3$, element 70 gives $140 + 94.0 = 234.0$. Element 71 gives $142 + 96.7 = 238.7$. Lutetium is the first knot above the line.

State I	Last knot under 236	First knot above
1	91, protactinium	92, uranium
2	78, platinum	79, gold
3	70, ytterbium	71, lutetium

One reading follows. It is a reading, not a derivation. At $I = 3$, every knot above 70 opens. What remains sits just under the line. Elements 57 to 70 are the rare earths. Lead, at 82, would open into the region that Europe is short of.

The theory therefore makes a plain statement. Which elements exist in a place is a function of the state of that place. Change the state and the list of stable knots changes.

6. What has been measured

The statement in Section 5 can be set against five bodies of measurement. They differ in standing. They are kept apart here.

6.1 Established: the state sets which knot is stable

The storage ring ESR at GSI in Darmstadt has measured three cases.

- **Dysprosium-163.** The neutral atom is stable. With all 66 electrons removed it becomes holmium-163, address 66 to 67. The half-life is 47 days. Jung and colleagues reported this in 1992. The step carries 50.3 keV per knot. That is $50.3 \times 10^3 \times 1.602 \times 10^{-19} = 8.06 \times 10^{-15} \text{ J}$, or $4.85 \times 10^9 \text{ J}$ per mole.

- **Rhenium-187.** The neutral atom has a half-life of 43 billion years. Fully ionized, it has a half-life of 32.9 years. That is nine orders of magnitude.
- **Thallium-205.** The neutral atom is stable. Fully ionized it becomes lead-205, address 81 to 82, with a half-life of 291 days. Leckenby and colleagues published this in *Nature* in November 2024.

In all three, nothing touched the knot. Only its surroundings changed. The knot then moved one address up.

The rates follow from the half-lives. The fraction that has moved after a time t is $1 - 2^{-(t/T)}$. For dysprosium that is 1.46% per day. For thallium it is 0.24% per day. For rhenium it is 2.1% per year.

Dysprosium is itself on the European list. It is used in permanent magnets.

6.2 Established: a cage sets the state

Beryllium-7 becomes lithium-7. Its half-life as a metal is 53.12 days. Ohtsuki and colleagues placed single beryllium-7 atoms inside cages of sixty carbon atoms. The half-life became 52.68 days. The difference is $(53.12 - 52.68) / 53.12 = 0.83\%$.

Different chemical surroundings give shifts of about 0.2%. High pressure gives shifts of the same order.

The effect is small. Its form matters more than its size. A cage is a mesh. The mesh was set, and the rate at which one element becomes another followed.

6.3 Reported and disputed: rare earths from a layered film

Iwamura and colleagues at Mitsubishi Heavy Industries let deuterium gas pass through a thin film of palladium and calcium oxide layers at 70 °C. They reported three changes on the surface.

From	To	Change in Z	Change in mass
Caesium-133	Praseodymium-141	4	8
Barium-138	Samarium-150	6	12
Tungsten (74)	Platinum (78)	4	—

The amount of praseodymium grew in proportion to the deuterium that passed. Toyota Central R&D Labs reported a nearly complete replication in 2013. Measurements at the SPring-8 synchrotron followed the change in place.

Two things stand out. Praseodymium and samarium are rare earths. And the reported steps obey the rotational rule of Section 3: the mass rises by exactly two for each unit of address. Eight for four. Twelve for six.

The quantities are of the order of nanograms. The field at large has not accepted the result. It stands as reported, replicated once, and unexplained.

6.4 Tested and not confirmed: the neutrino lever

Larson ties I to the concentration of neutrinos held in matter. Jenkins, Fischbach and colleagues reported from 2008 that decay rates follow the distance between Earth and Sun. They proposed solar neutrinos as the link.

Kossert and Nähle at the Physikalisch-Technische Bundesanstalt repeated the measurement with counters that track their own efficiency. They found stable activities and no oscillation. Norman and colleagues found none in six further isotopes.

This line does not carry. The state that moves a knot has been found in the electrons around it, not in a neutrino flux.

6.5 Reported, not independently repeated: living cultures

Vysotskii and Kornilova report that growing microbial cultures in heavy water turn manganese-55 into iron-57. The stated rate is 1.7×10^{-9} per nucleus per second. No independent replication was found for this essay.

6.6 Designed, not built: tonnes

Marathon Fusion published a design in 2025. Fast neutrons from a fusion plasma turn mercury-198 into mercury-197, which becomes gold-197 in about 64 hours. The computed yield is about 2 tonnes per gigawatt of thermal power per year. The design has not been built and has not passed review.

It is the long road: fire, neutrons, a plant. It is listed because it shows that quantity as such is not excluded.

7. What the record adds up to

Three statements can now be kept apart.

The state fixes which knot is stable. This is measured three times, at GSI, and is not disputed.

A mesh can set that state. This is measured once, in the carbon cage, at under 1%.

A layered structure yields rare earths. This is reported by one industrial laboratory and replicated by a second. It is not accepted.

The theory joins the three. Its fourth axiom says that constants are functions of the local state of the net. Its design work says that a mesh sets that state. If I is such a state function, the mesh is the lever for the knot.

That identity is open. The complete derivation of the theory lists it as open: its two descriptions of the state of the net have not been shown to be one quantity.

One further link has not been made by anyone. The Mitsubishi film is a stack of layers a few nanometres thick, with a flow through it. In the terms of the net it is a stack of meshes with one open passage. Nobody has read it that way, and nobody has varied the layer thickness against the natural unit of the theory.

8. The open number

The distance between the record and a kilogram is one number: the rate.

At GSI the state is set completely, and the rate is 1.46% per day for dysprosium. But the state is held in a ring that stores millions of ions, not grams. In the carbon cage the quantity is free, but the state shifts by less than 1%. In the Mitsubishi film both are small.

The price of the step is known for one case. The dysprosium step carries 4.85×10^9 J per mole. That is some ten thousand times a chemical step. It is also twenty thousand times less than a full mass unit. The knot does not have to be opened. It has to be moved one address.

What decides the matter is therefore a curve, not a principle. On one axis: how far a structure shifts the state. On the other: how fast the knot follows. Three points on that curve exist. They were measured for other reasons.

Two existing kinds of group can add points. A storage-ring group can repeat the dysprosium measurement at partial ionization, charge state by charge state. A thin-film laboratory can repeat the Mitsubishi film at a series of layer thicknesses, with a sham stack beside it.

9. What changes for people

The European plan rests on places. A tungsten mine in Spain. A germanium plant in Belgium. A recycling hall in Harderwijk. Behind them lie the places that are not in the plan: the cobalt diggings of Katanga, the rare-earth ponds of Inner Mongolia.

A raw material is scarce because it is somewhere else. Recycling shortens the journey. It does not end it. The copper in a Rotterdam circuit board still came from a hole in the ground.

If the state fixes the element, scarcity is no longer a matter of place. That would remove the reason for the mine, the export ban and the strategic list alike. It would also remove the work of the people who dig, ship and sort.

None of that is at hand. What is at hand is smaller. The seventeen materials on the list are not seventeen fixed stocks. At least three knots on or near that list have been seen to change address when their surroundings changed.

10. Status

- **From sources.** The European figures. Larson's mass rule and limit. The GSI half-lives. The beryllium shift. The Mitsubishi and Toyota reports. The PTB result.
- **Computed here.** The mass table. The limits at $I = 1, 2$ and 3 . The conversion rates. The price of the dysprosium step.
- **Read.** The rare earths as the knots just under the line at $I = 3$. The Mitsubishi steps as the rotational rule. The layered film as a stack of meshes.
- **Open.** Whether I is a state function that a mesh sets. The curve of state shift against rate.
- **Not carried.** The neutrino lever.

Annotated references

The occasion

Lalkens, P., and Schram, E. (2026). "Vier Nederlandse projecten bestempeld als 'strategisch' in EU-plan voor cruciale grondstoffen." *Het Financieele Dagblad*, 9 October 2026. *Why read?* The four Dutch projects, the three targets and the €21.1 billion, in one page. *Reading advice:* note the official's remark that no mine has opened in ten years.

European Parliament and Council (2024). Regulation (EU) 2024/1252, the Critical Raw Materials Act. *Why read?* The legal form of the idea that an element is a stock. *Reading advice:* Article 5 for the benchmarks, Annex I for the list.

The net

Konstapel, J. (2026). *The Vacuum.Net Theory: Foundational Paper*, sixth edition. Constable Research, Leiden. *Why read?* The five axioms, including the fourth, on which Section 7 rests. *Reading advice:* the ternary ground first.

Konstapel, J. (2026). *Applied Vacuum Theory, Part Four: Energy as Passage*, third edition. Constable Research, Leiden, 27 September 2026. *Why read?* The two roads, mesh and knot, and Larson's limit in numbers. *Reading advice:* Section 7.

Konstapel, J. (2026). *Three Roads to a Dynamic Vacuum*. Constable Research, Leiden, 6 October 2026. *Why read?* The measured record for the mesh, and the Dutch groups that hold the equipment. *Reading advice:* Sections 6 and 9.

Larson, D. B. (1988). *Basic Properties of Matter*. Salt Lake City: ISUS. Chapters 24, "Isotopes", and 25, "Radioactivity". *Why read?* Equation 24-1, the limit of 236, and the level I. Everything in Sections 3 and 5 comes from these two chapters. *Reading advice:* Chapter 24 in full. An engineer writing, not a professor.

The established measurements

Jung, M., et al. (1992). "First observation of bound-state β^- decay." *Physical Review Letters* 69, 2164. *Why read?* Stable dysprosium-163 becomes holmium when its electrons are removed. The founding measurement of Section 6.1. *Reading advice:* four pages; read all.

Bosch, F., et al. (1996). "Observation of bound-state β^- decay of fully ionized ^{187}Re ." *Physical Review Letters* 77, 5190. *Why read?* Nine orders of magnitude in a half-life, from the surroundings alone.

Leckenby, G., et al. (2024). "High-temperature ^{205}Tl decay clarifies ^{205}Pb dating in early Solar System." *Nature* 635, 321. *Why read?* The third case, thirty-two years after the first, and twice as slow as predicted. *Reading advice:* the methods section shows what holding a state costs.

Litvinov, Yu. A., and Bosch, F. (2011). "Beta decay of highly charged ions." *Reports on Progress in Physics* 74, 016301. *Why read?* The overview of every decay that changes with charge state. The place to look for further candidates on the European list.

Ohtsuki, T., et al. (2004). "Enhanced electron-capture decay rate of ^7Be encapsulated in C_{60} cages." *Physical Review Letters* 93, 112501. *Why read?* A cage changes a rate. Small, clean and undisputed. *Reading advice:* the comparison table of half-lives.

The disputed and the unrepeated

Iwamura, Y., Sakano, M., and Itoh, T. (2002). "Elemental analysis of Pd complexes: effects of D_2 gas permeation." *Japanese Journal of Applied Physics* 41, 4642. *Why read?* The original report of caesium to praseodymium through a layered film. *Reading advice:* the structure of the film, and the control without calcium oxide.

Hioki, T., et al. (2013). "Inductively coupled plasma mass spectrometry study on the increase in the amount of Pr atoms for Cs-ion-implanted Pd/CaO multilayer complex with deuterium permeation." *Japanese Journal of Applied Physics* 52, 107301. *Why read?* The Toyota replication, by a group with no stake in the first result.

Iwamura, Y., Itoh, T., and Tsuruga, S. (2015). "Transmutation reactions induced by deuterium permeation through nano-structured palladium multilayer thin film." *Current Science* 108, 628. *Why read?* The short summary: three element pairs, the synchrotron measurement, and the open problem of quantity.

Vysotskii, V. I., and Kornilova, A. A. (2010). *Nuclear Transmutation of Stable and Radioactive Isotopes in Biological Systems*. New Delhi: Pentagon Press. *Why read?* The only sustained experimental programme on elements changing in living cultures. *Reading advice:* the Mössbauer chapters; read as a report awaiting repetition.

The line that did not carry

Jenkins, J. H., et al. (2009). "Evidence of correlations between nuclear decay rates and Earth–Sun distance." *Astroparticle Physics* 32, 42. *Why read?* The claim that would have made Larson's neutrino level measurable.

Kossert, K., and Nähle, O. (2014). "Do radioactive decay rates depend on the distance between the Earth and the Sun?" *Proceedings of the 10th Patras Workshop*, DESY, 181–184. *Why read?* The careful repetition that found nothing. It shows where the lever is not.

The long road

Rutkowski, A., Harter, J., and Parisi, J. (2025). "Scalable chrysopoeia via $(n, 2n)$ reactions driven by deuterium-tritium fusion neutrons." *Marathon Fusion*, preprint. *Why read?* Tonnes per year, on paper. The upper bound of what the old method promises.