NEWVISTAS

The Atom in the Building

The 250-year bridge from the gas fuel cell to building-level nuclear, and the weapons made into fuel

November 4, 2026

Summary

Every NewVistas building begins with natural gas in a solid-oxide fuel cell, its carbon returned to the ground, and every building ends, within the 250 years, with a small reactor of its own whose heat is used where it is made. The Constitution already sets that destination; this study works out what stands between the two and how the bridge is crossed.

The case rests on density. Fission releases about **1.5 million times** the energy of burning the same mass of methane. To make the same electricity, nuclear takes **7.1 hectares** of land for each terawatt-hour a year; ground-mounted solar takes **2,000** and wind, counting the spacing between turbines, **12,000**. One community of 92,160 people, drawing an assumed 150 MW on average, would need about **10 square miles** of solar panels or **61 square miles** of wind farm, against its own farm area of 25 square miles at full build. Its reactors fit inside the utility storeys of its buildings.

Land is only the first ledger. Over the life of the equipment, wind and solar take **18 to 29 times** the critical minerals of a coal plant for the same electricity, **13 to 23 times** its copper and up to 25 times its steel. They wear out in 25 to 30 years and are rebuilt about **ten times** over the bridge, and today they end mostly in landfill: fewer than one US panel in ten is recycled, and blades are cut up and buried. Counted fairly, made reliable with the batteries, overbuild and grid they need instead of the coal and gas plants kept behind them today, they take about **760 times** coal’s critical minerals for the same delivered power. They mine as much rock and throw away as much equipment as coal mines and burns. Over their life they emit a quarter to half of coal’s carbon. Powering twelve billion people, wind would spread over one and a half times the whole NewVistas footprint of man, fragmenting the habitat of birds, bats and big game. Coal’s smoke and carbon came from burning it with poor science. They fall with filters, scrubbers and capture, and vanish when coal is processed and run in fuel cells rather than burned. Taken whole, over 250 years and at the scale of the world, solar and wind are as harmful to the environment as coal and oil, and their harm is renewed with every rebuilding.

The obstacles are not mainly physics. Four small reactors went critical in Idaho by July 4, 2026, a 1 MWe reactor is on its way to a full-power test, and the Nuclear Regulatory Commission has finished one new licensing rule and proposed another that allows factory-fuelled, remotely operated microreactors with no emergency planning zone. What stands in the way is fuel supply, the safeguarding of fissile material in a quarter of a billion buildings worldwide, siting a reactor where people live and sleep, waste, cost at volume, the training of people, public acceptance, and above all the will to finish. Society lost about two generations of progress after 1979 to fear. The bridge is 250 years long; it is enough, if it is used.

The world's nuclear weapons are the first fuel. About 1,100 tonnes of highly enriched uranium sit in or available for weapons. Blended down to the 19.75% fuel the building reactors need, it makes about **6,150 tonnes** of that fuel, roughly **3,000 to 4,000 terawatt-hours** of electricity with twice as much usable heat: the first cores of the first several hundred communities. The paper plans on every warhead dismantled within the first fifty years, by 2081, and the material used as feedstock, as the Megatons to Megawatts programme turned 20,000 Russian warheads into a tenth of America's electricity for fifteen years.

1. Where the Constitution stands

The Constitution has already ruled on the ends; this study fills in the means.

- **No land for fuel or energy.** "No land grows fuel and no land makes energy by wind or sun, for land is for food and for other species. No photovoltaic array, solar-thermal collector, or wind turbine stands anywhere in a community, its farm land, or its hinterland: none is made, refined, or recovered here, its life is short, and at a community's load it takes square miles of the land the community exists to save".
- **Gas is the bridge.** "Natural gas is the bridge, some 250 years, its carbon returned to the ground".
- **The destination.** "The destination is micro-scale fission or fusion at the building, never a central station, its heat used where made. Research toward it is a standing objective for the research Business Enterprises Bureau 13 solicits."
- **Bureau 23** (Department VIII). "As nuclear thermal systems become viable they replace the building's natural gas and its fuel cells, likely within 250 years; Bureau 23 revises the published numbers of the plant, for fuel cells and nuclear systems alike, as the technology progresses."
- **The heat rule.** "No heat leaves the building while any use remains".

What the Constitution does not yet say is how the bridge is crossed: in what order, through which gates, with what fuel, and what has to be true of society for the last step to be taken. That is this study's work.

2. Why density decides

The principle. The harm any energy source does to people and to the earth grows as its density falls. This is the conclusion of fifty years of the author's study of energy, and the record bears it out:

- **The historical ladder.** People moved from wood to coal, coal to oil, oil to gas, each denser than the last, and each step took less land and did less harm for the energy it gave.
- **Wood is worse than coal.** Smoke from wood, dung and charcoal burned at home kills about **3.2 million people a year** (WHO). Fuel grown on purpose takes **58,000 hectares** for each terawatt-hour a year, the most of any source, taking land from food and from every other species (see 2.3).
- **Solar and wind belong at the low end.** They are not fuels at all but thin flows of energy, gathered over wide areas, and so they take the land, the materials and the rebuilding that low density always demands.

Measured as power per square metre of land disturbed, the median of the published studies:

Source	Watts per square metre
Biomass	0.08
Hydro	0.14
Wind	1.84
Solar	6.63
Coal	135
Oil	195
Nuclear, central stations with their mines and exclusion areas	241
Natural gas	482
Nuclear in the building	no added land: the reactor stands in a utility storey already built

The rule has a second half. Every source does harm when it is handled without the best of science and the best of society:

- coal without filters;

- gas that leaks;
- a reactor without discipline.

Density sets the least harm a source must do; science and society decide whether it does more. Every carbon fuel, properly processed and run in a cell rather than burned in a flame, can run smokeless with all its carbon returned to the ground. The harm of the fossil age came from the flame, not from the fuel.

2.1 Energy in a kilogram

Burning a kilogram of methane releases about 55.5 megajoules. Fissioning a kilogram of uranium-235 releases about 82 million megajoules, roughly **1.5 million times** as much. That ratio is the whole argument in one number. It is why a reactor small enough to stand in a building’s utility storey can run for years without refuelling, why its fuel can be shipped in one sealed core, and why its mining, land and waste are tiny for the energy it gives.

Wind and sunlight carry no stored energy at all; they are gathered from a flow that is thin, intermittent and spread over the ground. Gathering it takes area, and area takes material.

2.2 Land

Land taken to make the same electricity, median hectares per terawatt-hour a year (Lovering et al. 2022).

The largest review of the land each source takes, about 1,400 observations, gives these medians in hectares for each terawatt-hour a year:

Source	Hectares per TWh a year	Times nuclear
Nuclear	7.1	1
Geothermal	45	6
Wind, turbine pads and roads only	130	18
Natural gas, footprint	410	58
Hydro, single-purpose dams	650	92
Coal	1,000	141
Solar thermal (CSP)	1,300	183
Solar PV, ground-mounted	2,000	282
Wind, with spacing between turbines	12,000	1,690
Biomass grown for fuel	58,000	8,169

For NewVistas the question is not abstract. The community exists to draw people close together and give back land: its farms are meant to shrink to 25 square miles a community as permaculture matures, and the farm belts are the scarcest land on earth.

One community’s power, measured in its own land.

At an assumed average draw of 150 MW (about 1.6 kW a person, data halls included), one community needs about **0.04 square miles** of land for nuclear by the median above, and its building reactors add nothing at all, standing on roofs that already exist. Ground-mounted solar would take about **10 square miles**, two-fifths of the community’s own farm area at full build. Wind would take about **61 square miles**: more than twice that farm area, or most of the whole ten-mile square, its turbines standing in the fields the community was founded to farm. Neither figure counts the storage needed to carry a still winter night.

2.3 Other species and the footprint of man

The key objective of NewVistas is to shrink the footprint of man so that every person, and every other living thing, has an equal chance at the earth. The Constitution measures it: today people use about **19 to 20 million square miles**, about a third of the earth’s land; at twelve billion in communities, about **6.3 to 7.3 million**, freeing **12 to 13 million square miles** to managed wilderness. Energy is where that objective is won or lost.

Power for twelve billion, measured against the footprint of man.

Powering 130,000 communities at an assumed 150 MW each, with the 25% overbuild that intermittent sources need:

Source	Land, world at twelve billion	Against the whole NewVistas footprint
Nuclear, median with mining	about 4,700 square miles	under a tenth of one per cent; zero more for reactors in buildings
Solar PV	about 1.6 million square miles	a quarter of it
Wind, with turbine spacing	about 9.9 million square miles	one and a half times it, and most of the wilderness it frees

In the United States alone, at build-out, wind would spread over about **420,000 square miles**, about **13.5%** of the lower 48 and three times the farm area all 5,552 communities need at maturity. Solar would cover about **70,000 square miles**, more than four times the built area of all the communities.

Wind's spaced land is not all paved: turbine pads and roads take about 1% of it, and crops or cattle can go on between them. But it cannot be wilderness, and for many animals it is no longer habitat.

- **Birds.** Turbines in the contiguous US killed about **234,000 birds a year** in 2012, about **4 for every megawatt** each year, eagles and hawks among them. A US built out on wind would kill on the order of **10 million birds a year**.
- **Bats.** More than **600,000 bats** died at US turbines in 2012, perhaps half as many again. Bats bear one or two young a year, so losses compound. For the hoary bat, the species most killed, models project declines of **up to 90% in fifty years** at present rates. A US built out on wind, at the 2012 rate of about ten bats a megawatt, would kill on the order of **25 million bats a year**.
- **Grassland and prairie birds** avoid turbines and their roads, so the habitat lost runs far beyond the pads.
- **Big game.** In Wyoming, pronghorn tracked by GPS collar before and after a fenced solar facility was built avoided it well beyond its fence. Their high-use habitat within a kilometre of the array fell **40% to 60%**. Fenced solar fields cut migration paths; in the Mojave desert tortoises are moved out of the way.
- **Farmland.** Of the US rural solar projects built from 2012 to 2020, **43% stood on cropland**, **70% in the Midwest**, the very prime farmland the communities need.
- **The mines behind them.** Mining areas already influence about **50 million square kilometres**, over a third of the earth's land outside Antarctica. **82%** of those areas target materials needed for renewable energy; they overlap protected areas, key biodiversity areas and remaining wilderness.

No land grows fuel. Biomass grown for energy is the lowest density of all, and it runs straight against the NewVistas purpose: land is for food and for other species, never for energy. The Constitution rules it out with sun and wind alike: "Land is for food and for other species, never for energy. No land grows fuel, food crop or other, and no land makes energy by wind or sun". Local waste goes up the food chain, to worms, insects, fish, chickens, hogs and the soil, never to fuel or energy.

- **One community.** At the median of **58,000 hectares** for each terawatt-hour a year, powering one community at 150 MW would take about **294 square miles** of fuel crops, three times its whole ten-mile square.
- **The world at twelve billion.** It would take about **38 million square miles**, two-thirds of all the land on earth: six times the whole NewVistas footprint, and more than all the land it frees for other species.

Wood, crops and pellets grown for fire are the old low-density road, and the worst of it.

Coal’s mines also strip land and its smoke harms living things far from the plant. But coal’s land is about 1,000 hectares for each terawatt-hour a year; wind with its spacing takes twelve times that, and solar twice. For a system whose purpose is to give land back, solar and wind go the wrong way: they take more of the earth with every unit of power, and they take it permanently, rebuilt every generation.

2.4 The equipment becomes the fuel

A coal plant burns its fuel and keeps its machine for forty or fifty years. A solar farm or a wind farm burns nothing, but its machine wears out in twenty-five to thirty years and has to be mined, refined, made, shipped, erected and thrown away again. Over the 250 years it is rebuilt about **ten times**. The equipment becomes the consumable. Its raw materials flow through it continuously, as coal flows through a boiler, and the flow never ends while the source is used.

Measured that way, as material for each terawatt-hour over the equipment’s life, wind and solar consume far more of the earth’s refined materials than coal does.

Rare and critical minerals for the same electricity, lifetime-adjusted (IEA 2021).

Material for each TWh over the equipment’s life	Coal plant	Nuclear	Solar PV	Onshore wind	Offshore wind
Critical minerals (IEA), tonnes	7	12	124	130	200
Times the coal plant	1	1.7	**18**	**19**	**29**
Copper (Bright New World), tonnes	3.0	2.5	68	39	—
Steel (US DOE / Bright New World), tonnes	310 / 160	165 / 130	7,900 / 940	1,920 / 1,450	—
Concrete and cement (US DOE / Bright New World), tonnes	870 / 450	760 / 1,060	4,050 / 1,220	8,000 / 4,470	—

Critical minerals here are copper, nickel, manganese, cobalt, chromium, molybdenum, zinc, rare earths and silicon. For the same electricity solar takes about **18 times** the coal plant’s, onshore wind **19 times** and offshore wind **29 times**. Copper runs **13 to 23 times** coal’s; steel **6 to 25 times**; concrete **3 to 10 times**. Copper ore is mined at well under one per cent metal, so every tonne of copper moves a hundred tonnes of rock or more, and the tailings stay behind.

Applied to the United States at build-out, 5,552 communities drawing an assumed 150 MW each, about 7,300 TWh a year:

Over 250 years, critical minerals only	Million tonnes
Solar PV	about 226
Onshore wind	about 237
Offshore wind	about 365
Nuclear	about 22
Coal plants (fuel not counted)	about 13

None of these counts the batteries, back-up plants and extra transmission that intermittent sources need and dispatchable ones do not. Section 2.8 adds them, and the gap grows from tens of times to hundreds.

2.5 Rare materials, concentrated and dirty to refine

- **Rare earths.** Permanent-magnet direct-drive turbines, the type preferred offshore because it removes the gearbox, need about **160 to 200 kg of rare earths for every megawatt**: neodymium, praseodymium, dysprosium and terbium. Their refining leaves acid and thorium-bearing tailings, and almost all of it is done in China.
- **Silver.** Solar cells took about **197 million ounces of silver in 2024**, roughly a sixth of all the silver the world used. The silver market has run short for six years straight. Silver is a by-product of other mining, so it cannot simply be mined faster.
- **Silicon and its makers.** Solar-grade polysilicon is refined at over 1,000 °C, much of it on coal-fired power. More than four-fifths of every stage of panel manufacture is in one country.
- **Cadmium, tellurium, lead.** Thin-film panels use cadmium telluride; most silicon panels carry lead in their solder. In a landfill these are low risk while the panel is intact, but they are why some states require testing before disposal, and why some panels must be handled as hazardous waste.

Coal’s own materials are vast in tonnage but common. Its burden is the mass mined and burned. The burden of wind and solar is in the scarce, refined metals that the whole of industry and every future technology also needs.

2.6 Short life and constant upkeep

- **Life.** Wind turbines were expected to last about 20 years; operators now hope for 25 to 30 with life extension. Solar panels are warranted for 25 to 30 years and lose about half a per cent of output each year. Their inverters are replaced every ten to fifteen. Panels and turbines are also retired early: hail and storms break them, and owners “repower” sites with newer machines long before the old ones fail.

- **Upkeep.** Operations and maintenance now make up about **25% to more than 35%** of the lifetime cost of onshore wind, a share that has grown, and costs rise once warranties end. Offshore the share is higher, for every repair means a vessel at sea. A turbine has gearboxes, bearings, pitch and yaw drives and a blade surface eroded by rain and sand. A heat-pipe reactor core has no moving parts at all.
- **Rebuilds over 250 years.** Solar and wind about **ten** times; a coal plant five to six; a nuclear plant about four, and at the building only the sealed core is changed.

2.7 Landfill: the end of the line today

- **Panels.** In the United States less than **one panel in ten** is recycled; about nine in ten retired panels go to landfill. Recycling a panel costs **$15 to $45**; landfilling it costs **$1 to $5**. As long as that gap stands, the landfill wins. The world was projected to hold **60 to 78 million tonnes** of retired panels by 2050. For every terawatt-hour a solar farm makes, about **1,250 tonnes** of panels are eventually thrown away, glass, aluminium, polymer, silicon and metals bonded together and hard to separate.
- **Blades.** Wind-turbine blades are glass or carbon fibre in epoxy, built not to break. Retired blades are cut up and buried, and the industry itself has asked Europe to ban landfilling them. The world is projected to retire about **43 million tonnes** of blades by 2050, more than **2 million tonnes a year** by then, with China, Europe and the United States holding most of it.
- **Coal’s waste, for comparison.** Coal leaves ash, about a tenth of the coal burned, roughly 50,000 tonnes for each terawatt-hour. It too goes largely to ponds and landfills, though about half or more is now used in concrete and wallboard. Coal’s waste is heavier; the waste of wind and solar is the machine itself, more complex, harder to recycle, and repeated every generation.

2.8 Firming: batteries, back-up and grid, the fair comparison

A coal, gas or nuclear plant delivers power when it is needed. Wind and solar deliver when the weather allows. To compare them fairly, wind and solar must carry the cost of being made reliable. Today that is done with batteries, extra capacity that is often curtailed, more transmission, and a fleet of gas and coal plants kept ready behind them.

- **What the weather requires.** Thirty-six years of hourly US weather show that wind and solar, with a continent-wide grid and **at least 12 hours of storage**, could reliably meet about four-fifths of demand. The last fifth, the windless winter weeks, needs either **weeks of storage** or a large surplus of generation used only rarely, or dispatchable plants behind them (Shaner et al., 2018).
- **What happens in practice.** In November 2024 a windless spell cut German wind output by about a quarter against the year before. Gas-fired generation rose **79%** in

one month, the largest monthly rise on record, and coal reached a twenty-month high. The fossil fleet is not retired by wind and solar. It is kept, and run when they fail.

- **Batteries wear out too.** A lithium-iron-phosphate battery holds about **2 kg of critical minerals for each kWh** (lithium, graphite, copper) in its cells alone. It weighs about **7 kg** a kWh with its enclosure. Its manufacture emits roughly **60 to 140 kg of CO_2** for each kWh, and it lasts about fifteen years.

For each terawatt-hour delivered on demand, solar and wind as a mix:

	Critical minerals, t	Life-cycle CO_2, g/kWh	Land, ha per TWh a year	Equipment retired, t	Rock moved for the batteries, t
Solar and wind alone, as usually compared	127	about 30	7,000	720	—
+ 12 h of batteries, 25% overbuild, gas for the last fifth	317	about 137	7,100	1,360	15,000
+ 4 days of batteries, 40% overbuild, no fossil	1,640	86–144	9,800	6,100	120,000
+ 2 weeks of batteries, 50% overbuild, no fossil	**5,300**	**200–400**	**10,500**	**19,000**	**420,000**
Coal plant, for comparison	7	about 820	1,000	about 50,000 of ash	about 500,000 of coal burned, plus overburden
Nuclear, for comparison	12	about 12	7.1	about 2.5 of spent fuel	—

Made reliable, solar and wind multiply their minerals.

Made reliable without fossil fuel, solar and wind:

- take **about 760 times** coal’s critical minerals for the same delivered power;
- emit **200 to 400 g of CO_2 a kWh** over their life, a quarter to a half of coal’s and in the range of gas, once their batteries are counted;
- move about **420,000 tonnes of rock** for each terawatt-hour for the batteries alone, the same order as the 500,000 tonnes of coal a coal plant burns;
- throw away about **19,000 tonnes of equipment** for each terawatt-hour, the same order as coal’s 50,000 tonnes of ash, but as composite, glass and chemical waste that is harder to recycle.

Made reliable the way it is actually done, with fossil plants behind them, they bring coal and gas along with them.

The battery and overbuild figures are this study's model, built on the published numbers above. Every assumption is stated so it can be checked: a 50-50 mix of solar and wind; batteries at 2 kg of critical minerals, 7 kg of mass and 60 to 140 kg of CO_2 a kWh, replaced every fifteen years; and rock moved at about 300 tonnes for each tonne of lithium, 200 for copper and 10 for graphite. They leave out transmission. Even the 12-hour case assumes a continent-wide high-voltage grid, and every new line is more copper, aluminium, steel and cleared corridor.

2.9 Weighed against coal and oil, measure by measure

Every row is for the same electricity, delivered when it is needed. Solar and wind are taken made reliable without fossil fuel, with two weeks of batteries and 50% overbuild, as the fair comparison requires.

Measure	Coal	Solar and wind made reliable	Nuclear	Worse
Critical and rare minerals, t/TWh	7	about 5,300	12	**Solar and wind, about 760 times**
Copper, steel, concrete	low	5 to 25 times coal before batteries	lowest	**Solar and wind**
Land, ha per TWh a year	1,000	about 10,500	7.1	**Solar and wind, about 10 times**
Habitat: birds, bats, big game, prairie	mines and smoke	turbines, fences and spaced land over a tenth of a continent	negligible	**Solar and wind**
Equipment life, years	40–50	panels and turbines 25–30, batteries 15	60–80	**Solar and wind**
Rebuilds in 250 years	5–6	about 10, batteries about 17	about 4	**Solar and wind**
Rock mined, t/TWh	about 500,000 of coal, plus overburden	about 420,000 for the batteries, plus the generators' ore	small	**Same order**
Waste, t/TWh	about 50,000 of ash, half reused	about 19,000 of composites, glass, panels and cells, mostly landfilled today	about 2.5 of spent fuel	**Same order; solar and wind harder to recycle**
Life-cycle CO_2, g/kWh	about 820 burned in a boiler; roughly 150–250 captured from a boiler; at the plant none, gasified and run in fuel cells with all its carbon returned	about 200–400	about 12	Coal burned in a boiler; **coal in a fuel cell is lower**
Air pollution, deaths per TWh	24.6, mostly from boilers run without the best controls; essentially no smoke from coal in a fuel cell	not burned; mining and manufacture only	0.03	Coal burned in boilers; **not coal in a fuel cell**

Made reliable and counted whole, solar and wind are worse than coal on seven of these ten measures and match it on two, the rock mined and the waste thrown away.

Coal's remaining two measures are a record of how coal was used, not of coal. Its smoke and its carbon came from burning it with poor science:

- **Filters, scrubbers and catalysts.** A modern plant's fabric filters take out more than **99%** of the particulates, its scrubbers about **98%** of the sulphur, and its catalysts most of the nitrogen oxides; mercury comes out with them. Many of the plants behind the death rate in the table ran with few or none of these.
- **Deaths fall when the controls go in.** A study of 480 US coal plants found that around the Keystone plant in Pennsylvania deaths from its pollution averaged more than **600 a year** before scrubbers were installed and fell below **100 a year** after.
- **Carbon can be caught.** Captured from a boiler's flue and returned to the ground, coal's life-cycle carbon falls to roughly **150 to 250 g/kWh**. That is already about even with solar and wind made reliable.
- **Not burned at all.** Properly processed, every carbon fuel can run smokeless with all its carbon returned, so long as it is not burned in a flame. Coal is gasified in a closed vessel, its sulphur and ash taken out, and the clean gas fed to solid-oxide fuel cells. Or its carbon is fed straight to a carbon fuel cell. Either way the oxygen reaches the fuel through the ceramic and the air never touches it, so the exhaust is carbon dioxide and steam alone, with nothing to separate. Coal gasification with solid-oxide cells has been shown to capture all its carbon dioxide, the sulphur sequestered with it, at efficiency well above a boiler's. Laboratory carbon fuel cells turn about 80% of the carbon's energy into electricity and yield a pure stream of carbon dioxide. This is the same principle as the community's own building plant, whose cell keeps its gas from the air and sends its carbon back to the ground.

Of all the carbon fuels, natural gas is the easiest to return. That is why the Constitution makes gas, not coal, the bridge.

- **It arrives clean.** It is a gas, its sulphur and water taken out at the field, with no ash and no gasifier needed.
- **It goes into the cell as it is.** The solid-oxide cell reforms methane inside itself, so the building's plant is the whole chemical works.
- **It carries the most hydrogen for its carbon,** four atoms to one. For each gigajoule it makes about **50 kg of CO_2**, against about **70** for oil and **88** for bituminous coal, so it leaves the least carbon to return for the energy it gives.
- **Its carbon goes back the way it came,** down qualified wells into the formations that held it.

- **It can give up its carbon as a solid.** Split by heat in the district pyrolysis works, methane becomes hydrogen and solid carbon, with no carbon dioxide at all. The carbon goes to the farms as biochar and to building materials, and the hydrogen comes back as fuel.

Processed with the best of science and run in a cell rather than burned, coal is smokeless and its carbon goes back to the ground entire; only the mining and processing remain. Its last two measures then fall below those of solar and wind made reliable, and it keeps about a tenth of their land and under a seven-hundredth of their critical minerals.

That is the density principle at work. Coal is denser than wood, solar or wind, and when it was handled badly the harm came from the handling.

This is the sense in which this paper holds that solar and wind are **as harmful to the environment as coal and oil**. Their harm takes a different form: mines, tailings, fenced and spaced land, lost habitat and landfill, rather than smoke. It is no bridge that ends. It is renewed with every rebuilding for as long as they are used, and over 250 years at the scale of twelve billion people it is a comparable claim on the earth. For the objective of reducing the footprint of man, it is worse: no other way of making power takes so much land from every other species.

Only nuclear is low on every line at once. That is why the Constitution keeps solar and wind out of the communities, and why the bridge leads to the atom.

3. What the building asks of a reactor

3.1 The load

The NV Build papers size the plant on the public building, the largest in the community: two fuel-cell modules, **650 kW installed**, drawing about **300 kW for the building, 60 for the greenhouse and 160 for its data hall**. The building's exhaust at **356 to 384 °C** fires the absorption chillers, its heat is banked in the 284 m³ pool, and the supercritical-water waste tube runs at **650 °C**. Each of the community's **1,982 buildings** carries its own plant in a utility storey of seven grids.

A reactor that replaces the fuel cell must therefore:

- deliver from about **100 kW to 1 MW** of electricity, the public building at the top of the range and the apartment buildings well below it;
- deliver its heat hot enough to drive the absorption cooling and, better, the 650 °C waste tube directly;
- fit the utility storey's bays and floor loading;

- run for years without being opened, and be changed as one sealed unit.

3.2 Every unit of heat used

A fission plant turns roughly a third of its heat into electricity; two units of heat come with every unit of power. At a central station that heat is thrown into a river or the sky. In the building it is the point. High-temperature gas-cooled and heat-pipe reactors run their outlets at about 650 to 750 °C, hot enough to fire the chillers, heat the waste tube directly, warm the water and the greenhouse and, through the pool, carry the building through the night. The rule of *The Building Data Centre* holds unchanged: no heat leaves the building while any use remains. This is the efficiency a central station can never have, and the reason the Constitution says “never a central station”.

When the reactor heats the waste tube, the methane the tube makes no longer feeds a fuel cell. It becomes feedstock: hydrogen, carbon for the farms as biochar, and chemicals.

3.3 What exists today

Reactors of about the right size and kind are being built now.

- **Radiant’s Kaleidos**, a 1 MWe helium-cooled reactor on TRISO fuel, left California on August 13, 2026 for the DOME test bed at Idaho National Laboratory, where its tests are to end in a 150-hour continuous full-power run. It is built to travel by road, sea or air.
- **Four microreactors**, from Antares, Valar Atomics, Deployable Energy and Aalo Atomics, reached criticality at Idaho under DOE’s Reactor Pilot Program between early June and July 4, 2026. Each must still pass NRC review before commercial use.
- Heat-pipe designs of a few megawatts, such as Westinghouse’s eVinci, are in licensing.
- **Kilowatt-scale cores exist.** NASA’s KRUSTY test of 2018 ran a 1 kWe-class core, and NASA’s lunar fission programme aims at about 100 kWe. A sealed reactor at the apartment building’s scale of a few hundred kilowatts is within physics; it is an engineering, fuel and licensing problem.

The building reactor is therefore one step smaller than today’s smallest commercial designs, at the public building about the same size. That step is the first research objective.

4. Where society stands

4.1 Two generations lost

After Three Mile Island in 1979 and Chernobyl in 1986, almost no new reactors were ordered in the United States for a generation, and the industry's supply chain, skills and cost discipline decayed. Germany closed its last three reactors in April 2023. Over the same decades the world built coal at a pace that has cost millions of lives in air pollution. The fear was of radiation; the harm came from what was built instead.

Fukushima shows the pattern exactly. The United Nations Scientific Committee (UNSCEAR) found radiation health effects among the public "unlikely to be discernible", and Japan has recognized one worker's death as caused by radiation. More than two thousand disaster-related deaths in Fukushima Prefecture followed the evacuation itself, most among the elderly and ill moved from hospitals and homes. The lesson for a reactor in every building is not that radiation is harmless; it is that measured, published risk must govern, not dread.

4.2 The turn now under way

- **Law.** The NRC published its final Part 53 rule in March 2026, a risk-informed, technology-inclusive licensing path for advanced reactors, with design approvals expected in 18 months or less. In May 2026 it proposed **Part 57 for microreactors**: no defined emergency planning zone where an accident cannot exceed 1 rem at the site boundary; remote monitoring, remote and autonomous operation; reactors built and **fuelled at the factory** under a manufacturing licence; and security sized to consequences. The ADVANCE Act of 2024 extended the Price-Anderson liability framework to 2065.
- **Fuel.** Centrus has delivered 900 kg of HALEU to DOE, and the Savannah River Site has approval to downblend weapons-origin HEU into about 3.1 tonnes of HALEU. Supply remains the tightest constraint on every small reactor.
- **Opinion.** Gallup's March 2026 poll found **46%** of Americans wanting more emphasis on nuclear, its highest reading, the only source to gain since 2021, while support for more solar and wind fell. Most Americans still resist a plant in their own area.

The last point is the hardest for this paper. A reactor in the building is the plant in one's own area, at the closest possible range.

5. The levels of issue, and how each is met

The transition fails if any one level fails. Each level is listed with what must become true, and how the community system meets it.

1. Physics and engineering. A sealed core of 100 kW to 1 MW that shuts itself down and cools itself with no power, no operator and no water (walk-away safety), and stays shut through fire, flood and quake. *Met by:* TRISO and heat-pipe designs already claim this; Bureau 13's research enterprises take the building-scale core as a standing objective, and a community offers the first fleet buyer.

2. Fuel. HALEU, 5% to 19.75% uranium-235, in volume. *Met by:* weapons HEU first (section 6), then new enrichment, then recycled fuel. Below 20% enrichment uranium is not usable for a weapon without re-enrichment.

3. Scale and safeguards. At full build the United States holds about **11 million** building plants, world area 1 about **28 million**, the world at twelve billion about **258 million**. Each is a place where fissile material sits. *Met by:* - **no plutonium ever enters a building core**: plutonium of any grade can make a weapon, so it is burned only in national reactors and later in the fuel enterprises' own recycling plants; - every core is fuelled at the factory and **never opened on site**; - spent TRISO fuel is among the hardest of all fuels to reprocess; - every core is continuously monitored, its location, temperature, power and seal published, with SI watching for any anomaly and accountable humans deciding; - cores move only between the building and the fuel enterprise's plant, under a published custody record.

4. Siting where people live. No licensing framework yet contemplates a reactor beneath an apartment floor. *Met by:* the gates of section 7. Reactors stand first in industrial and logistics buildings beside the transfer yards, then in the public buildings, and in apartment buildings only after a published operating record and at a size whose worst accident gives no meaningful dose beyond its own utility storey. The utility storey becomes the shielded room: fire-rated compartments already, mass added below the core.

5. Security and cyber. *Met by:* the consequence-based security of Part 57, a core that cannot be made to melt or to release its fuel, controls that fail safe, and a cybersecurity standard Bureau 23 publishes with Bureau 15 verifying it.

6. Waste. *Met by:* spent cores return whole to the fuel enterprise. For long-term disposal the communities already drill and qualify deep formations to return carbon; the same skills serve **deep borehole disposal** in qualified formations kilometres down. Later, spent fuel is recycled in fast-spectrum reactors at the fuel plants, which burn the long-lived actinides and leave waste whose radioactivity falls to that of the original ore in a few centuries rather than many thousands of years.

7. Decommissioning. *Met by:* the core is a module; the building outlives many cores. Ending a reactor is lifting out a sealed unit.

8. Cost. Microreactors cost far more today, per kilowatt, than the stations they would replace. *Met by:* the same argument the NV Build papers make for the fuel cell. Ten thousand identical plants a year, the volume of five communities a year, is what moves a machine down its learning curve, and decentralisation is what makes the cheap machine possible. A community orders cores as it orders fuel cells: one design, built 1,982 times.

9. Liability and insurance. *Met by:* the national framework (Price-Anderson to 2065) at first; later the operating record of millions of reactor-years, which insurers price as they price every other risk.

10. People and skills. *Met by:* the schools teaching what radiation is and is not, from the first years; Business Enterprises in reactor custody, maintenance and monitoring; the fuel enterprise as a career path.

11. Acceptance. *Met by:* choice, data and ownership. - Each building's radiation readings, inside and out, are published live, as its water and air are. - A building's residents hold the first right to decline a reactor on their roof, and see the record of those who did not. - The community holds the reactor's title, and the residents are its owners through the community: the reactor is theirs, not a utility's.

12. Will. The deepest issue. A society that started down this road in the 1950s turned back for two generations; the next 250 years may hold their own Fukushima. *Met by:* the Constitution naming the destination and the gates, so that a bad year slows the crossing but does not abandon it; Bureau 13's standing objective; and a published checkpoint every decade that measures where the bridge stands.

6. Swords into fuel: the weapons as feedstock

6.1 What exists

At the start of 2026 the Federation of American Scientists counted about **12,187 nuclear warheads**: about 9,745 in military stockpiles and about 2,442 retired and awaiting dismantlement, nearly all of them American and Russian.

The International Panel on Fissile Materials counted, at the start of 2025:

- about **1,240 tonnes of highly enriched uranium**, of which about **1,100 tonnes** sit in or are available for weapons;
- about **570 tonnes of separated plutonium**, of which about **140 tonnes** sit in or are available for weapons. Russia holds about 88 tonnes and the United States about 38.

6.2 What has been done before

From 1993 to 2013 the **Megatons to Megawatts** programme blended down **500 tonnes** of Russian weapons uranium, the equivalent of about **20,000 warheads**, into nearly 15,000 tonnes of reactor fuel. For years up to a tenth of all US electricity came from it. It ran on commercial terms: a buyer that wanted fuel made the disarmament pay for itself.

6.3 What the remaining weapons uranium is worth

Blended down to 19.75% with depleted uranium, 1,100 tonnes of weapons HEU makes about **6,150 tonnes of HALEU**, exactly the fuel the building reactors need. Burning 40% to 50% of its uranium-235 gives about **9,000 to 11,000 terawatt-hours of heat**, of which about **3,200 to 3,900 TWh** is electricity at a third’s efficiency and the rest heat the building uses.

At the assumed 1.2 to 1.6 TWh a year for one community, that is **2,200 to 2,900 community-years**: the first cores of several hundred communities for a decade. It is not the world’s fuel for long. It is the startup fuel for the first generation of building reactors, available when new HALEU enrichment is still scarce.

The 140 tonnes of weapons plutonium would give about **1,100 TWh** of electricity if fully fissioned. Under the rule of section 5 it never enters a building. It is burned in national reactors as mixed-oxide fuel, or later in the fuel enterprises’ fast reactors.

6.4 The fifty-year target

The paper plans on every warhead dismantled within the first fifty years, by 2081, and its uranium and plutonium in the fuel cycle. Whether that happens is decided by nations, not by NewVistas. NewVistas takes no political stance; its participants vote and hold office like anyone. What the communities offer is what made Megatons to Megawatts work: a steady commercial buyer, in this case for fuel made from weapons, with a use that turns every tonne into homes, schools and farms.

7. The crossing, stage by stage

The 250-year bridge, from the fuel cell to the atom in the building.

Stage	Years	What happens	Gate to the next
0. Gas	from 2031	Gas in solid-oxide cells in every building, carbon returned to the ground. Bureau 13 solicits building-core research. Communities sign as the first fleet buyer.	A building-scale core licensed for a non-residential building.
1. Non-residential buildings	about 2045 to 2090	First reactors in the industrial and logistics buildings beside the transfer yards; weapons HEU made into their fuel.	Ten years and a published operating record across many cores.
2. Public buildings	from about 2060	The public buildings, the largest plants, change from fuel cells to reactors. The reactor heats the waste tube directly.	A core of a few hundred kilowatts, a record of public buildings, and the consent of each apartment building's residents.
3. Apartment buildings	about 2075 to 2150	Reactors in apartment buildings as each building chooses. Fuel cells kept for a time as back-up.	All buildings converted; gas use falls to chemistry and back-up.
4. Closed cycle	from about 2110	Spent fuel recycled in fast reactors at the fuel enterprises' plants; thorium fuels; uranium recovered from seawater. Gas lines and carbon-return wells closed.	—
5. Fusion	if it proves out	Fusion at the building if it reaches the building's scale. The bridge does not wait for it.	—

The bridge ends when the last building's gas is shut off. That is within the 250 years if each gate is passed on time, and well before it if acceptance comes faster than this study assumes.

7.1 Fuel for the long age

Once the bridge is crossed, fuel is not the limit. The oceans hold about **4.5 billion tonnes** of dissolved uranium, renewed from the rocks as it is drawn. Thorium is about three times as common in the earth's crust as uranium. With breeding and recycling, fission can carry a world of twelve billion for many thousands of years on less land than a single farm belt's towns occupy today.

8. The rule proposed

The study proposes this rule for the building plant:

The crossing. The building plant changes from gas to fission in stages, each opened by a published gate: first the industrial and logistics buildings, then the public buildings, then the apartment buildings as each building's residents choose. Every core is fuelled at the factory, sealed, never opened in the community, and returned whole to the fuel enterprise; no plutonium enters a building core. Each building's radiation readings are published live. The heat of the core is used in the building, none leaving while any use remains, and its waste tube is heated by the core directly. Fuel made from the uranium

of dismantled weapons is preferred while it lasts. Bureau 23 publishes the gates and the record against them each decade; Bureau 13 holds the building-scale core as a standing research objective until it is licensed for every building.

Sources

- Lovering, Swain, Blomqvist and Hernandez, Land-use intensity of electricity production and tomorrow's energy landscape, PLOS ONE, 2022.
- Breakthrough Institute, Updated Mining Footprints and Raw Material Needs for Clean Energy, April 2024.
- Our World in Data, Death rates from energy production per TWh (Markandya and Wilkinson 2007; Sovacool et al. 2016). Lifecycle CO_2: IPCC AR5 (2014) medians.
- IRENA and IEA-PVPS, End-of-Life Management: Solar Photovoltaic Panels, 2016. Wind blades: Liu and Barlow, Waste Management, 2017.
- Neutron Bytes, Four micro reactors hit criticality milestones by July 4th, July 8, 2026.
- Radiant, Kaleidos has left the building, August 2026.
- American Nuclear Society, NRC unveils Part 53 final rule, March 26, 2026.
- Beveridge & Diamond, NRC Proposes New Licensing Framework for Microreactors (proposed Part 57), June 2026.
- POWER, Centrus completes 900 kg HALEU delivery to DOE; ANS, Savannah River Site could produce 3.1 MT of HALEU.
- Gallup, Less support for solar, wind energy; more for nuclear, April 22, 2026; NucNet, US support for greater emphasis on nuclear is highest to date.
- Bulletin of the Atomic Scientists, Counting the dead at Fukushima, March 2026; UN finds 'no adverse health effects' from Fukushima disaster (UNSCEAR 2020/2021); Fukushima Daiichi nuclear disaster casualties.
- IEA, The Role of Critical Minerals in Clean Energy Transitions (2021), kg/MW and lifetime-adjusted t/TWh, with Bright New World and US DOE Quadrennial Technology Review (2015) steel, concrete and copper, as tabulated by the World Nuclear Association, Mineral Requirements for Electricity Generation.
- Öko-Institut, Rare earths: a bottleneck for future wind turbine technologies?, 2011 (160 to 200 kg of rare earths per MW, direct drive).
- Metals Focus and the Silver Institute, via FXStreet, Silver's solar paradox, June 2026.
- Wiser et al., Assessing wind power operating costs in the United States, LBNL, 2019.

- pv magazine USA via Ground News, the cost gap between recycling and disposal, June 2026; Yale E360 via Mother Jones, April 2023 (under 10% recycled; landfill and hazardous-waste rules).
- Liu and Barlow, Wind turbine blade waste in 2050, Waste Management, 2017; WindEurope call for a Europe-wide landfill ban on blades.
- van Zalk and Behrens, The spatial extent of renewable and non-renewable power generation (Energy Policy, 2018), median power densities, via Surface power density; WHO, Household air pollution and health.
- Shaner, Davis, Lewis and Caldeira, Geophysical constraints on the reliability of solar and wind power in the United States, Energy & Environmental Science, 2018, via Carnegie Science.
- Reuters/LSEG via Zawya, Germany's weak winds trigger record surge in gas-fired power, November 2024.
- Battery materials: Battery Design, key minerals in a battery; battery manufacturing emissions (Ecoinvent via ADEME), Nos Gestes Climat.
- Loss, Will and Marra, Estimates of bird collision mortality at wind facilities in the contiguous United States, Biological Conservation, 2013; Hayes, BioScience, 2013, via phys.org; Frick et al., Fatalities at wind turbines may threaten population viability of a migratory bat, Biological Conservation, 2017.
- The Wildlife Society, Ungulates turn away while humans embrace solar; USDA ERS, Agricultural land near solar and wind projects, 2024; Sonter et al., Renewable energy production will exacerbate mining threats to biodiversity, Nature Communications, 2020, via phys.org.
- Henneman et al., Science, 2023, via Scientific American, Coal power kills a staggering number of Americans; Power Engineering, Raising the bar for pulverized coal (over 99% particulate and 98% sulphur removal); coal with carbon capture, IPCC AR5 (2014), Annex III.
- AIChE 2009, Coal power generation with high efficiency and near-zero emissions (coal gasification with solid-oxide cells, all CO_2 captured); Lawrence Livermore National Laboratory, Direct carbon conversion (about 80% efficiency, pure CO_2 stream); Integrated gasification fuel cell with CO_2 near-zero emission and its challenges.
- US EPA, GHG Emission Factors Hub, 2024: natural gas 53.06, distillate oil 73.96, bituminous coal 93.28 kg CO_2 per million Btu.
- Federation of American Scientists, Status of World Nuclear Forces, early 2026.

- International Panel on Fissile Materials, The 2025 update on fissile material stocks, June 2026.
- Megatons to Megawatts Program; Centrus, Megatons to Megawatts.
- NewVistas: the Constitution (November 4, 2026); NV_Build, The Buildings of the Community (October 23, 2026).
- Calculations: firmed systems a 50-50 mix of solar and wind, batteries 2 kg of critical minerals, 7 kg and 60 to 140 kg CO_2 a kWh, 15-year life; world at twelve billion 130,000 communities at 150 MW; panels about 55 t a MW, capacity factor 20% for 25 years; blades 13 t a MW, wind at 33% for 25 years; coal about 0.5 t a MWh and ash a tenth of it; fission energy 82 TJ per kg of U-235; HEU at 90% blended to 19.75% with 0.2% tails; 35% conversion to electricity; community draw 1.5 to 2.0 kW a person, 92,160 people.