APIS GUIDE 07 · BUILDINGS

HVAC-R *lifecycle costing.*

Why the cheapest tender is rarely the cheapest system — and how to make tenderers compete on what the plant will actually cost you over twenty years.

APIS · HVAC-R DIVISION

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ABOUT THIS GUIDE

The purchase price is the *smallest number.*

Over the life of a heating, ventilation, cooling or refrigeration system, what you pay to buy it is routinely the smaller part of what you pay to have it. Energy, maintenance, downtime and eventual replacement usually add up to considerably more — and every one of those is decided at the moment of purchase, by people evaluating a price.

Lifecycle costing is the discipline of making that visible before the decision rather than after. It is not complicated, it is not new, and it is very rarely applied — because a purchase price is a fact and a lifetime cost is a calculation, and calculations lose to facts in a tender evaluation unless somebody has decided in advance that they will not.

This guide covers what the cost elements are, how to set the study period and the assumptions, why energy dominates almost every case, how maintenance and obsolescence behave, and — most usefully — how to write a tender that makes bidders compete on lifetime cost rather than on purchase price. It ends with a forty-point checklist you can attach to a specification.

> WHAT THIS GUIDE WILL NOT GIVE YOU
>
> **No prices, no energy tariffs, no equipment service lives, no maintenance rates and no discount rate.** Every one of those is specific to your organisation, your market and the year you are reading this, and a figure printed here would be wrong somewhere and out of date everywhere.
>
> What it gives you instead is the structure: which elements belong in the calculation, where each number comes from, which assumptions decide the answer, and how the exercise is manipulated by people who would rather you compared purchase prices.

Who this is written for

- Building owners and operators specifying or replacing HVAC and refrigeration plant
- Public bodies and municipalities bound by procurement rules, where the evaluation method must be published in advance
- Facility and estates managers who inherit what somebody else bought
- Finance directors and boards asked to approve the more expensive option
- Consultants and contractors preparing or evaluating tenders

What this guide is not

It is not a design document, and it does not replace a qualified mechanical designer or a cost consultant. It covers the **economic comparison of technical alternatives** — not the design of the systems themselves, and not the wider question of whether the building needs them.

How to use it

If you are preparing a tender, Section 07 is the operative section and the rest is the reasoning behind it. If you are evaluating options already in front of you, start at Section 02 and work forward. If you are trying to persuade somebody that the expensive option is the cheap one, Section 01 and Section 04 are the arguments that usually work.

Contents

SECTIONS

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SECTION 01

Why the cheapest tender is rarely *the cheapest system.*

Three mechanisms turn a low purchase price into a high lifetime cost, and all three are invisible on the day of the award.

Nobody sets out to buy an expensive system. The problem is structural: the purchase price is known, certain and comparable, while the lifetime cost is estimated, contingent and arrives after the person making the decision has moved on. A tender evaluated on price selects reliably for the option that costs least to buy, and only incidentally for the option that costs least to own.

Mechanism 1 — Efficiency is expensive to buy and cheap to own

Higher efficiency generally costs more: more heat exchanger surface, better compressors, variable speed drives, better controls, larger ducts and pipes with lower resistance. Each of those adds to the tender price and subtracts from the energy bill, every hour, for twenty years.

Because the plant will run for tens of thousands of hours, a small efficiency difference compounds into a large sum. A price comparison sees only the first half of that trade.

Mechanism 2 — Maintainability is designed in, and it is invisible

Two air handling units with identical duties can differ enormously in what they cost to maintain: whether a coil can be withdrawn without dismantling the unit, whether filters can be changed by one person, whether there is space and light and access, whether the drain actually drains. None of this appears in a schedule of duties, and all of it is paid for every year by somebody who was not in the room.

Mechanism 3 — The cheapest option often has the shortest life

Lower-cost plant frequently has a shorter service life, thinner spares support, and a greater likelihood of becoming unsupported before it wears out. If one option lasts fifteen years and another twenty-five, comparing their purchase prices compares two different things — and the shorter-lived option carries a second purchase inside the comparison period that nobody has counted.

> *A tender evaluated on price is not choosing the cheapest system. It is choosing the system whose costs are most successfully deferred beyond the evaluation.*

The two moments when lifecycle costing actually changes something

1. **Choosing between technical alternatives.** Which system type, which efficiency class, which configuration. Here the discipline earns most of its value, because the alternatives genuinely differ in their cost profile over time.
2. **Evaluating tenders for the same specified system.** Here it is narrower but still worthwhile, because bidders can and do differ in efficiency, in maintenance requirement and in the support they offer — and a well-written evaluation lets them compete on that rather than only on margin.

THE ARGUMENT THAT USUALLY WORKS

Not “this option is more efficient”. Finance directors have heard that, and it sounds like a preference.

“Over the period we intend to hold this building, option B costs this much less in total, and here are the three assumptions the answer depends on.” That is a comparison in the same currency as everything else on their desk, and it invites scrutiny of the assumptions rather than of the conclusion — which is exactly where you want the conversation, because the assumptions can be defended.

Where it does not help

Lifecycle costing compares alternatives. It does not decide whether to act at all, it does not capture benefits that are not costs — comfort, reliability, compliance, emissions — and it cannot rescue a decision whose real driver is something other than money. Where the decisive factor is clinical, regulatory or reputational, say so, and use lifecycle costing to choose between the options that satisfy it rather than to justify the choice.

SECTION 02

The cost *elements.*

Seven categories. Most comparisons include two of them and call the result a lifecycle cost.

ISO 15686-5 provides the international framework for life cycle costing of buildings and constructed assets, and EN 15459 sets out an economic evaluation procedure specifically for energy systems in buildings. Both organise cost into broadly the categories below. What matters is less which framework you adopt than that the same categories are applied to every option being compared.

Element	What it contains	Where the number comes from
Capital cost	Equipment, installation, controls, commissioning, design fees, builders' work, electrical supply, structural provision, and any works required to accommodate the plant	The tender, plus the associated costs the tender does not include. See the warning below
Energy	All fuels and electricity consumed by the system across the year, at part load as well as full load, including auxiliaries — fans, pumps, controls, trace heating	Calculated from seasonal efficiency figures and the building's load profile. See Section 04
Planned maintenance	Scheduled servicing, filters, consumables, statutory inspections, refrigerant leak checking, water treatment, cleaning	The manufacturer's schedule, priced. Ask tenderers to price their own recommended regime — see Section 07
Reactive maintenance and repair	Unplanned failures, call-outs, component replacement within the service life	The hardest element to estimate, and the one where reliability data and operator experience matter more than any published figure
Replacement within the period	Components with a life shorter than the study period — compressors, drives, controls, actuators, and whole plant items where the study period exceeds their life	Service life estimates, with the replacement cost including access and disruption
Downtime and consequence	What a failure costs beyond repairing it — lost production, spoiled stock, closed rooms, temporary hire, reputational cost	The operator's own data. Frequently the largest element in an industrial or cold storage context, and almost always omitted
End of life	Decommissioning, refrigerant recovery, removal, disposal or recycling — less any residual value	Often small, occasionally not. Refrigerant recovery and disposal obligations belong here

CAPITAL COST IS NOT THE TENDER SUM

Two options with the same equipment price can carry very different associated costs: a larger electrical supply, additional structural provision, a bigger plant room, longer distribution, a crane, a road closure, acoustic treatment, or works to accommodate a heavier unit.

Establish the **fully installed and enabled** cost of each option, including everything the option obliges you to do. A comparison of equipment prices between two systems with different installation requirements is not a comparison.

The two elements most often omitted

Downtime

In a cold store, a data room, a hospital theatre or a production line, the cost of the system not working can exceed everything else in the calculation combined. It is omitted because it is difficult to estimate, not because it is small.

It does not need to be precise. An order-of-magnitude figure for the cost of an hour, a shift or a day of loss, multiplied by a defensible expectation of unavailability, changes the ranking of options far more often than any refinement of the energy figure. Ask the operations team; they will know the number even if nobody has written it down.

Refrigerant

For refrigeration and air conditioning systems, refrigerant carries costs across the whole period: the initial charge, leak checking and record-keeping obligations, top-up charges, and — most significantly — the effect of regulatory phase-down on availability and price. A system containing a refrigerant being withdrawn from the market has a shorter economic life than its physical condition suggests, and that shortening belongs in the calculation. Section 06 returns to this.

CONSISTENCY BEATS PRECISION

A lifecycle comparison does not need every element to be accurate. It needs every element to be **applied identically to every option**. An assumption that is wrong but consistent will usually preserve the ranking; an element included for one option and omitted for another will reverse it.

State every element, for every option, even where the entry is zero or “not applicable” — and be suspicious of any comparison where the categories differ between columns.

SECTION 03

Period, discount rate and the assumptions *that decide the answer.*

Four choices, made before any cost is entered, that determine the outcome more than the costs themselves.

1 · The study period

The period over which costs are compared. Three common bases, and they give different answers:

- **The expected service life of the principal plant —** the natural technical choice, but it favours whichever option happens to last longest
- **The owner's intended holding period —** the honest commercial choice for an investor, and it may be far shorter than the plant life
- **A standard period set by policy —** common in public procurement, and it has the advantage of being published in advance and applied to everyone

Whichever is chosen, **the same period must apply to every option**, and any option whose life is shorter than the period must carry its replacement inside the calculation. Any option whose life extends beyond the period should carry a residual value. Comparing a fifteen-year option against a twenty-five-year option over "their lives" is not a comparison.

2 · The discount rate

Future costs are worth less than present ones, and discounting expresses that. The rate chosen has a large effect: a high rate makes future energy and maintenance costs matter less, which favours cheap plant; a low rate favours efficient plant.

Use your organisation's own rate if it has one, or the rate mandated by the applicable procurement rules. **State it, and test the result at a higher and a lower rate.** If the ranking changes across a plausible range, that is the most important finding in the study and it should be reported rather than buried.

> THE DISCOUNT RATE IS WHERE A COMPARISON IS MOST EASILY STEERED
>
> Whoever sets the discount rate can often decide the outcome without touching a single cost. Set it before the options are known, publish it, and apply it to all of them. In a public tender, publish it in the tender documents — it is part of the evaluation method, not an internal working assumption.

3 · Energy price and its trajectory

The most influential single assumption in most HVAC-R comparisons, and the least knowable. Two rules:

- **Use the full delivered price**, including network, levies and taxes as applicable — not the energy component alone. A comparison built on the commodity price understates the value of efficiency substantially.
- **Present a range rather than a forecast.** Show the result at a low, central and high price path, and state which assumption the recommendation depends on. A single forecast presented with confidence is the least credible thing in the document.

4 · Service life assumptions

How long each option is assumed to last, and how long its major components last. Sources, in descending order of reliability:

1. **Your own records** for equivalent plant in equivalent duty — by far the best, and almost nobody keeps them. Starting to keep them is a recommendation in its own right.
2. **Published indicative service lives** from recognised industry sources — a reasonable starting point, always requiring adjustment for duty and environment.
3. **The manufacturer's figure** — useful, and it assumes their maintenance regime is followed.

Service life is not a property of the equipment alone. The same unit in a coastal, dusty or corrosive environment, or running at continuous full load, will not last as long as one in a clean plant room at part load. Adjust, and say what you adjusted and why.

> RUN THE SENSITIVITY, AND REPORT IT
>
> Vary, one at a time: the discount rate, the energy price path, the service life of the principal plant, and the maintenance cost. Then report which of them can change the ranking and which cannot.
>
> A study that says "option B is cheaper, and remains cheaper across the whole plausible range of assumptions" is a decision. A study that says "option B is cheaper" is an invitation to argue about assumptions — and whoever prefers option A will accept it.

What the output should look like

Three things, and no more:

1. **Total lifecycle cost per option**, discounted to present value, on the same period and assumptions.
2. **The breakdown by element**, so the reader can see where the difference comes from — which is almost always energy, and it is more persuasive shown than asserted.
3. **The sensitivity**, showing which assumptions could change the answer.

Anything beyond that is working, and belongs in an appendix.

SECTION 04

Energy — the element that *usually dominates.*

And the one most often estimated from the wrong number: the rated efficiency at full load, which the plant almost never operates at.

HVAC and refrigeration plant spends most of its operating hours at part load. Outdoor conditions are mild more often than they are extreme, occupancy varies, and systems are routinely sized for a design condition that occurs for a handful of hours a year. A comparison built on rated full-load efficiency compares two machines in a state neither of them will spend much time in.

Rated efficiency and seasonal efficiency

Figure	What it tells you
Rated efficiency at standard conditions	Performance at one specified operating point, measured under defined test conditions. EN 14511 provides the rating basis for air conditioners, liquid chilling packages and heat pumps. Useful for like-for-like product comparison; **not** a basis for annual energy calculation
Seasonal efficiency	Performance weighted across a range of operating conditions representing a season. EN 14825 provides the calculation basis for part-load conditions and seasonal figures. This is what belongs in a lifecycle calculation

The gap between the two can be large, and it is not consistent between products: a unit that looks better at the rating point may be worse across the season, particularly where one has variable-capacity control and the other cycles on and off. **Require seasonal figures from every tenderer, on the same basis, or the comparison is not valid.**

> ASK FOR THE PART-LOAD PERFORMANCE, NOT THE HEADLINE
>
> Request the efficiency at each of the defined part-load conditions, from the same test standard, for every option. Then weight them against the load profile your building actually produces — which is why the interval data described in the energy audit guide in this series is useful here too.
>
> A tenderer who can supply part-load data has a product tested to the standard. One who supplies only the headline figure is either unable or unwilling, and both are informative.

The auxiliaries, which are frequently omitted

The energy consumed by a system is not only the energy consumed by its primary plant. In many installations the auxiliaries are a substantial share, and they are almost always excluded from an equipment comparison because they belong to a different part of the design.

- **Fan energy.** Moving air is expensive, and fan power depends on the resistance the system presents. Specific fan power — the electrical power required per unit of air moved — is the figure to compare, and it is addressed within the EN 16798 series. A duct system designed with generous cross-sections and low-loss components costs more to build and less to run, every hour, for decades
- **Pump energy.** The same logic for water systems: pipe sizing, valve selection, variable speed control and correct balancing all decide it
- **Controls, actuators, trace heating and standby.** Individually small, continuously present

- **Defrost, crankcase heaters and other refrigeration parasitics**, which in a cold-store context are far from trivial

> THE DISTRIBUTION SYSTEM IS PART OF THE EFFICIENCY DECISION
>
> A high-efficiency air handling unit connected to an undersized, high-resistance duct system will consume more in fan energy than the unit saves. Ducts and pipework are sized once and live for the life of the building — usually longer than the plant they serve — and they are the first thing value-engineered when a project is over budget.
>
> Where a lifecycle comparison is being made, include the distribution in it. Otherwise the exercise optimises the visible box and ignores the system it sits in.

Control strategy — the efficiency that is not in any datasheet

Two identical systems, one properly commissioned and controlled and one not, will differ in annual consumption by more than most equipment choices. Weather compensation, optimum start, setback, zoning, demand-controlled ventilation, sequencing of multiple units, and the avoidance of simultaneous heating and cooling are all decided in design and commissioning, and all produce savings that no product comparison captures.

Where a lifecycle study compares options with different control capability, that capability must be reflected in the assumed annual consumption — and, critically, **only if the controls will actually be commissioned and maintained**. Claiming the benefit of a control strategy nobody will configure is the most common overstatement in this exercise.

Performance degradation over life

Plant does not perform in year fifteen as it did in year one. Heat exchangers foul, filters load, refrigerant charge drifts, controls are overridden, and components wear. A lifecycle calculation using year-one efficiency for the whole period will overstate the energy performance of every option — and it will overstate it most for the option most dependent on being maintained.

Either apply a degradation assumption, or state explicitly that year-one performance is assumed throughout and that the maintenance regime is therefore load-bearing. Do not do neither.

SECTION 05

Maintenance, reliability *and access.*

Decided at design stage, paid for every year, and almost never evaluated at tender.

Maintenance cost is not a property of equipment alone. It is a property of the equipment, its duty, its environment and — above all — how easy it is to reach. A unit installed where a coil cannot be withdrawn, a filter cannot be changed by one person, or a compressor cannot be lifted without dismantling something else, will cost more to maintain for its entire life than an identical unit installed properly.

Planned maintenance

The scheduled regime, priced. What to establish for each option:

- The manufacturer's required schedule, task by task and frequency by frequency — because failure to follow it commonly voids the warranty
- Consumables: filters, belts, seals, water treatment chemicals, and their expected replacement interval in your duty rather than in a catalogue
- Statutory inspection requirements — pressure systems, refrigerant leak checking and record-keeping, water hygiene, electrical
- Specialist attendance: whether the work can be done by a general technician or requires a manufacturer-authorised engineer, which changes the rate substantially
- Labour hours per visit, which is where access matters

Reactive maintenance

The hardest element to estimate honestly, and the one where operator experience beats any published figure. Three approaches, in descending order of reliability:

1. **Your own reactive call history** for equivalent plant — the reason the reactive call log is worth keeping
2. **The operator's or maintainer's judgement**, expressed as an annual allowance and applied identically to comparable options
3. **A percentage allowance** applied to capital cost — crude, and defensible only if applied consistently and clearly labelled as a placeholder

> ACCESS IS A LIFECYCLE COST DECISION TAKEN ON A DRAWING
>
> Before any plant layout is approved, confirm for every item:
>
> - Can the largest replaceable component be withdrawn and removed from the plant room without dismantling anything else?
> - Is there a route by which the whole unit can eventually be replaced?
> - Can filters, belts and sensors be reached safely by one person?
> - Is there lighting, power and space to work?
> - Can the unit be isolated and drained without shutting down something else?
>
> Every "no" is an annual cost for the next twenty years, and a much larger one on the day of replacement. These questions cost nothing at design stage and are effectively unfixable afterwards.

Spares, support and the supply chain

- **Spares availability and lead time —** a component with a twelve-week lead time is a twelve-week outage unless one is held
- **Local support —** whether the manufacturer has service presence in your market, or whether every visit is an import
- **Whether spares are proprietary** or generic. Proprietary parts on a long-life asset are a commercial exposure as well as a technical one
- **Controls support —** whether the control system is open or proprietary, whether it can be maintained by anyone other than the installer, and whether you hold the software and the credentials. A proprietary control system whose supplier withdraws is a replacement, not a repair

Reliability, and what a failure actually costs

Where the consequence of failure is significant, reliability belongs in the comparison explicitly — through the downtime element from Section 02, and through the design decisions that mitigate it:

- **Redundancy.** Two smaller units instead of one large one usually cost more to buy, more in maintenance, and considerably less in consequence — and they run closer to their efficient load range for more of the year, which frequently pays for part of the difference in energy
- **Modularity**, so that a failure degrades capacity rather than removing it
- **Standardisation across the estate**, so that spares are shared and technicians are familiar
- **Monitoring and early warning**, so that a developing fault is found before it becomes an outage

> MAKE TENDERERS PRICE THEIR OWN MAINTENANCE
>
> Require every tenderer to submit their recommended maintenance schedule **and a priced offer to deliver it** for a defined number of years. This does three useful things at once: it produces a real maintenance figure for the lifecycle calculation instead of an estimate; it discourages the equipment optimism that a supplier can afford when somebody else maintains it; and it reveals which tenderers have local support and which do not.
>
> You are not obliged to buy the maintenance. Requiring it to be priced is what makes the number honest.

SECTION 06

Obsolescence, replacement *and end of life.*

Plant is usually replaced because it can no longer be supported, not because it has worn out.

Lifecycle calculations built on physical service life systematically overstate how long equipment will be kept. In practice, the decision to replace is usually triggered by one of three things — and none of them is the machine ceasing to function.

1 · Refrigerant

The regulatory phase-down of refrigerants with high global warming potential is the single largest obsolescence factor in HVAC-R at present. A system charged with a refrigerant subject to withdrawal faces rising cost and falling availability for top-up and service, well before the machine wears out.

The practical consequences for a lifecycle comparison:

- **Establish the refrigerant of every option**, and its regulatory status where the building is, at the time of the decision
- **Assume a shorter economic life** for an option using a refrigerant being phased down, and say so — the alternative is a calculation that assumes twenty years of servicing that may not be possible
- **Check whether a retrofit path exists** to an alternative refrigerant, what it costs, and what it does to capacity and efficiency, because a retrofit is rarely performance-neutral
- **Account for the leak checking, record-keeping and recovery obligations** that attach to the charge

This guide names no regulation and no date, because the position differs between markets and changes. **Establish it in writing for your location before the comparison is built** — it is the assumption most capable of reversing a ranking.

2 · Controls and digital obsolescence

Mechanical plant frequently outlives its control system by a wide margin. A controller that is no longer supported, a communication protocol that is no longer current, or software that will not run on a supported operating system can force the replacement of functioning equipment.

Two questions at tender stage reduce the exposure substantially: **is the control system open or proprietary**, and **who holds the software, the licences and the credentials**. A system that can only be maintained by the company that installed it is a commercial position as well as a technical one, and it should be priced as such.

3 · Changed requirements

The building changes: occupancy, use, hours, layout, a regulatory requirement, a new tenant. Plant that cannot adapt is replaced regardless of its condition. Where a change is foreseeable within the study period, flexibility has a value and it belongs in the comparison — modular capacity, spare connections, headroom in the electrical supply, room to extend.

ECONOMIC LIFE, NOT PHYSICAL LIFE

Use the shorter of the two throughout, and state which governs for each option and why. A comparison assuming twenty-five years of physical life for a system likely to become unsupportable at year twelve is not conservative — it is wrong, and it is wrong in the direction that favours the cheaper purchase.

End of life

- **Decommissioning and refrigerant recovery**, which carries regulatory obligations and must be done by competent personnel
- **Removal**, including access and any structural or crane requirement — the same route that was needed to install it, twenty years later, in a building that may have changed around it
- **Disposal or recycling**, against the waste requirements applicable at the time
- **Residual value**, where the plant has life remaining at the end of the study period. Usually modest, occasionally material, and it should be applied consistently to every option or to none

THE REPLACEMENT COST IS NOT THE PURCHASE COST

Replacing plant in an occupied, operating building costs a multiple of installing it in an empty one: access, temporary provision, out-of-hours working, disruption, making good, and sometimes lost production. Where the study period includes a replacement, price it as a replacement — not as a repeat purchase.

This is also the argument for designing the removal route at the outset, which costs nothing on a drawing and a great deal on the day.

SECTION 07

Putting lifecycle cost *into a tender.*

The operative section. Everything before it is reasoning; this is how the reasoning changes an award.

A lifecycle study performed after tenders are received rarely changes anything, because the bidders optimised for the criteria they were given. To make lifetime cost matter, it has to be in the evaluation method, published before bids are submitted, and expressed in a way that cannot be gamed.

Step 1 — Publish the evaluation method in advance

State in the tender documents that award will be determined on lifecycle cost, and set out exactly how it will be calculated: the study period, the discount rate, the energy price and its assumed path, the operating hours and load profile, and the elements included. Where public procurement rules apply, publishing the method in advance is normally a requirement in any case.

The effect is immediate. Bidders who know the evaluation formula will bid to it — which is the entire purpose. A bidder with efficient plant now has a reason to offer it.

> FIX THE OPERATING ASSUMPTIONS YOURSELF
>
> The single most important instruction in this section. **You** state the operating hours, the load profile, the energy price and the price path, and every bidder calculates against them.
>
> If bidders supply their own assumptions, they will supply the ones that flatter their equipment — and the resulting numbers cannot be compared at all. Fixing the assumptions turns a set of incomparable claims into a genuine competition on efficiency.

Step 2 — Require the inputs, not the conclusion

Do not ask bidders to submit a lifecycle cost. Ask them to submit the inputs, and calculate it yourself. Required from every bidder:

- **Seasonal efficiency figures** to a named test standard, with the part-load data behind them
- **Auxiliary power** — fan and pump power at the duty specified, and standby consumption
- **The recommended maintenance schedule**, task by task and frequency by frequency
- **A priced offer to deliver that maintenance** for a stated number of years
- **Expected service life** of the plant and of major replaceable components, with the basis stated
- **Refrigerant type and charge**, with its regulatory status and any retrofit path
- **Spares lead times** and the location of service support
- **Controls** — open or proprietary, who can maintain them, who holds the software and licences
- **Everything the offer obliges you to provide** — electrical supply, structural provision, plant room space, access, acoustic treatment

Step 3 — Calculate identically, and show the working

Apply the same period, rate, price path and hours to every bid. Publish the resulting breakdown by element alongside the totals — which both demonstrates fairness and shows exactly where the difference arises, usually in energy.

Step 4 — Decide how the criterion is weighted

Approach	How it works, and when it suits
Lifecycle cost as the price criterion	Total lifecycle cost replaces tender price entirely in the evaluation. The cleanest expression of the principle, and it requires confidence in the assumptions because they now determine the award
Weighted scoring	Lifecycle cost is scored alongside quality, delivery and other criteria at a published weighting. The common approach where non-cost factors also matter
Minimum performance thresholds	Minimum seasonal efficiency, maximum specific fan power, maximum refrigerant global warming potential — set as pass/fail requirements, with price evaluated among compliant bids. Simpler to administer, and it captures much of the benefit without a full calculation

The third approach deserves consideration where a full lifecycle evaluation is disproportionate to the value of the contract. Setting a floor on seasonal efficiency and a ceiling on fan power removes the worst options without any modelling at all, and it is straightforward to write and to defend.

Step 5 — Make the claims contractual

An efficiency figure in a tender that carries no consequence is an aspiration. Three mechanisms give it weight:

- **Performance verification at commissioning**, against the tendered figures, with the method and the tolerance stated in the specification
- **Priced maintenance held to the tendered rate** for the stated period, so that a low maintenance quotation cannot be revised upward after award
- **Liquidated remedies** where a performance shortfall is measurable and material — a legal question for your advisers, and one worth asking

> VERIFY WHAT YOU EVALUATED
>
> If bids were compared on seasonal efficiency and specific fan power, those are the things to measure at commissioning. A tender won on figures that are never tested teaches every bidder what the figures are worth — and the next tender will be bid accordingly.

SECTION 08

Getting the data, and the tricks *to watch for.*

Eight ways a lifecycle comparison is steered, all of them recoverable if you know where to look.

Where each number comes from

Number	Best source, in order
Capital cost	Tendered price, plus your own cost consultant for the enabling works each option obliges
Seasonal efficiency	Certified performance data to a named standard; third-party certification where available; manufacturer's declaration last
Operating hours and load profile	Your own interval consumption data and building schedule — not a bidder's assumption
Energy price	Your own bills, full delivered price by component
Maintenance cost	Bidder's priced offer for their own recommended schedule; your existing maintainer's view as a cross-check
Reactive cost	Your own reactive call history for equivalent plant; the maintainer's judgement otherwise
Service life	Your own records first; published indicative lives second; manufacturer third — adjusted for duty and environment
Downtime cost	Your operations team. They know it
Discount rate	Your finance function, or the applicable procurement rules

Eight ways the comparison gets steered

1. **Rated efficiency substituted for seasonal efficiency.** The most common, and it favours whichever product performs best at the single rating point. Require seasonal figures with the part-load data behind them.
2. **Auxiliaries excluded.** Fan and pump power omitted because they are "outside the equipment scope". Specify that they are in scope and must be stated at the duty.
3. **Different operating hours per option.** Sometimes innocent, always decisive. Fix the hours yourself.
4. **Optimistic service life on the cheaper option.** Apply the same basis to all, and require the basis to be stated.
5. **Maintenance understated.** Countered by requiring a priced offer to deliver the schedule, held for the stated period.
6. **Enabling works omitted.** The larger electrical supply, the structural provision, the crane. Require every option to state what it obliges you to provide.
7. **A discount rate chosen after the options are known.** Set it and publish it first.
8. **Energy price held flat over twenty years** where a rising path is more plausible, which understates the value of efficiency. Present a range, and say which assumption the recommendation depends on.

THE SINGLE QUESTION THAT EXPOSES MOST OF THEM

“Show me your calculation, with every input, on the assumptions I published.”

A comparison built properly can be reproduced. One that cannot be reproduced was not built — and any input that appears only in the conclusion, without a stated source, is the one to examine first.

What to keep afterwards

The study is also a record, and it is worth more later than it appears at the time. Retain: the assumptions and their sources; the tendered performance figures, which become the commissioning targets; the maintenance schedule and its price, which becomes the budget; the service life assumptions, which become the replacement forecast; and the calculation itself, which becomes the starting point for the next comparison.

Then record what actually happened — measured consumption, actual maintenance cost, actual failures. Within a few years that dataset is worth more than any published figure, and it is the reason an organisation’s second lifecycle study is far better than its first.

SECTION 09

The forty-point *checklist.*

Attach it to the specification. If every box can be ticked, the evaluation will select the system that costs least to own.

A · SETTING UP THE COMPARISON

- ☐ Study period stated, and applied identically to every option
- ☐ Replacement included for any option whose life is shorter than the period
- ☐ Residual value applied where life extends beyond the period — to all options or none
- ☐ Discount rate set and published before the options are known
- ☐ Energy price stated as a full delivered price, by component
- ☐ Energy price path stated, with a range rather than a single forecast
- ☐ Operating hours and load profile fixed by the client, not by bidders
- ☐ Every cost element listed for every option, including entries of zero or not applicable

B · CAPITAL AND ENABLING

- ☐ Fully installed and enabled cost established, not the equipment price
- ☐ Every option states what it obliges the client to provide
- ☐ Electrical supply capacity implications identified for each option
- ☐ Structural, plant room and access implications identified
- ☐ Distribution — ducts and pipework — included in the comparison, not only the plant

C · ENERGY

- ☐ Seasonal efficiency required from every bidder, to a named test standard
- ☐ Part-load data supplied behind every seasonal figure
- ☐ Auxiliary power stated — fan, pump, controls, standby, defrost
- ☐ Specific fan power stated at the specified duty
- ☐ Control strategy capability reflected, and only where it will be commissioned and maintained
- ☐ Performance degradation applied, or its omission stated explicitly
- ☐ Efficiency figures set as commissioning targets in the specification

D · MAINTENANCE AND RELIABILITY

- ☐ Manufacturer's maintenance schedule obtained for every option
- ☐ Priced offer to deliver that schedule required for a stated number of years
- ☐ Specialist attendance requirements identified, with rate implications
- ☐ Statutory inspection obligations included
- ☐ Reactive allowance applied on a consistent basis across options
- ☐ Access checked — largest component withdrawable, unit removable, one-person tasks, lighting, isolation
- ☐ Spares lead times and local service presence established
- ☐ Controls confirmed open or proprietary, with software and licence ownership stated
- ☐ Downtime cost estimated with operations and included in the calculation
- ☐ Redundancy and modularity evaluated against the consequence of failure

E · OBSOLESCENCE AND END OF LIFE

- ☐ Refrigerant type, charge and regulatory status established for every option
- ☐ Economic life used where it is shorter than physical life, and stated
- ☐ Retrofit path to an alternative refrigerant identified, with its cost and performance effect
- ☐ Leak checking, record-keeping and recovery obligations included
- ☐ Decommissioning, removal and disposal costed, with the removal route confirmed
- ☐ Foreseeable changes of use or capacity reflected in the flexibility of each option

F · MAKING IT COUNT

- ☐ Evaluation method published in the tender documents before bids are submitted
- ☐ Bidders required to submit inputs; the client performs the calculation
- ☐ Sensitivity run on discount rate, energy price, service life and maintenance, and reported
- ☐ Evaluated figures verified at commissioning, with method and tolerance specified

Evaluation sign-off

Complete and retain with the tender file.

LIFECYCLE COST EVALUATION SIGN-OFF

Item	Name and role	Date and signature
Project and plant		
Study period and discount rate		
Operating assumptions fixed by		
Calculation performed by		
Sensitivity reviewed by		
Checklist points 1–40 confirmed		
Evaluation method approved for issue by		

IF YOU CAN ONLY DO THREE THINGS

One. Publish the evaluation method — period, rate, energy price, operating hours — in the tender documents, so bidders compete on lifetime cost.
Two. Fix the operating assumptions yourself and require seasonal efficiency with the part-load data behind it.
Three. Require every bidder to price the maintenance schedule they recommend — it makes the maintenance number honest and reveals who has local support.

REFERENCE

Standards referred to *in this guide.*

Listed by number and subject so that you can obtain and read them. Confirm the current edition and the applicable national adoption before citing any of them.

STANDARDS REGISTER

Reference	Subject
ISO 15686-5	Buildings and constructed assets — service life planning: life cycle costing
EN 15459 series	Energy performance of buildings — economic evaluation procedure for energy systems in buildings
EN 60300-3-3	Dependability management — application guide: life cycle costing
EN 14511 series	Air conditioners, liquid chilling packages and heat pumps — terms, definitions, test conditions and rated performance
EN 14825	Testing and rating at part-load conditions, and calculation of seasonal performance
EN 13053	Ventilation for buildings — air handling units: rating and performance for units, components and sections
EN 1886	Ventilation for buildings — air handling units: mechanical performance of the casing
EN 16798 series	Energy performance of buildings — ventilation for non-residential buildings, including specific fan power
EN 15316 series	Energy performance of buildings — method for calculation of system energy requirements and system efficiencies
ISO 55000 series	Asset management — the framework within which lifecycle planning sits
EN 13306	Maintenance terminology
ISO 50001	Energy management systems

HOW TO USE THIS REGISTER — AND WHAT GOVERNS ABOVE IT

Standards are revised, withdrawn and superseded. Verify the current edition with the national standards body applicable to your project, and confirm that the clause you intend to rely on still says what you think it says. Nothing in this guide should be relied upon as a statement of the content of any standard.

Where public procurement rules apply, they govern the evaluation method above anything in this guide — including whether lifecycle cost may be used as an award criterion, how it must be published, and how it must be calculated. Establish the applicable rules before the tender is drafted.

About APIS

APIS is an integrated engineering group founded in Kosovo, operating across the Western Balkans and into the European Union. The Group delivers mechanical, electrical, energy and infrastructure works through twenty-one delivery divisions across two strategic business units — Building Systems & Technologies, and Energy, Industry & Infrastructure — supported by four engineering excellence centres. APIS operates management systems certified to ISO 9001, ISO 14001, ISO 45001 and ISO 50001.

The **HVAC-R Division** designs, installs, commissions and maintains heating, ventilation, air conditioning and refrigeration systems to ASHRAE, EN and Eurovent practice, with energy recovery, building management integration and performance monitoring. Work is delivered under the Group's DBOM lifecycle model — design, build, operate and maintain — which means the party that specifies the plant also carries the cost of running it.

Prepared by the APIS HVAC-R Division · **Document** APS-GD-07 issue v1.0 of 20 August 2026 · **Contact** apisgroup.net/contact

About to award on price, and not sure *what it will cost you?*

Our engineers will build the lifecycle comparison, write the evaluation method into your tender documents so bidders compete on lifetime cost, and verify at commissioning that the plant delivers what it was awarded on.

SPEAK TO THE HVAC-R DIVISION

Lifecycle cost comparison of technical options · tender evaluation methods · seasonal efficiency and part-load analysis · maintenance and replacement forecasting · refrigerant transition planning · commissioning verification

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