The FCB Advisory Services CDLA Framework

A Practical Framework for Strategic Decision Support in the Bioeconomy

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Publication statement

The FCB Advisory Services CDLA Framework
First published by FCB Advisory Services, July 2026.
This publication presents Critical Decision Lever Analysis (CDLA) as developed by FCB Advisory Services and its application to biological and bioeconomy decision-making. It does not claim ownership of the established analytical disciplines on which the framework draws

1 Executive summary

Complex biological and bioeconomy projects contain many interacting variables, but only a limited number materially determine whether a project succeeds, fails or requires redesign. The central decision problem is therefore not simply to identify every variable that may influence performance. It is to determine which variables matter most, which can be influenced in practice, and where further evidence or investment is likely to change the decision.

Critical Decision Lever Analysis (CDLA), developed by FCB Advisory Services, provides a structured approach to this problem. Its application to the interconnected biological, feedstock, engineering, logistics and commercial decisions that characterise bioeconomy projects is referred to as Bioeconomy-CDLA. The framework combines system understanding, evidence evaluation, systems modelling, sensitivity analysis, uncertainty analysis and decision analysis to identify Critical Decision Levers: the variables or intervention points at which action can materially improve a project outcome or reduce decision risk.

The CDLA is not presented as a new analytical discipline. Its foundations are established and widely used. Systems thinking examines relationships and feedback within complex systems; systems modelling makes those relationships explicit; sensitivity and uncertainty analyses examine the influence of assumptions and incomplete knowledge; and decision analysis provides methods for evaluating alternatives and trade-offs. The contribution of the FCB Advisory Services framework lies in integrating these methods around a practical question:

Where can intervention create sufficient improvement in system performance to justify action?

This distinction is important. A variable may strongly influence an outcome but remain outside the control of the project. Another variable may be easy to change but have little effect. A Critical Decision Lever occurs where **influence, actionability, feasibility, uncertainty and expected value** come together.

The framework is intended for strategic decision support in agriculture, biomass production, renewable fuels, circular bioeconomy systems and related natural-resource projects. Within these applications, Bioeconomy-CDLA is the principal focus of the FCB Advisory Services framework. It complements rather than replaces detailed scientific, engineering and financial analysis

2 Why another framework?

The bioeconomy operates at the intersection of biological production, engineering conversion, logistics, markets and investment. Each part of this chain is influenced by different sources of variability and uncertainty.

Crop yield varies with genotype, environment and management. Biomass properties vary with development stage, harvest timing and storage. Engineering performance depends on feedstock specifications, equipment design and operating conditions. Commercial outcomes depend on scale, price, logistics, capital requirements and market assumptions. A change in one part of the system can propagate through several others.

These projects are commonly examined through separate agronomic, technical, financial and market studies. Each may be competent within its own scope, yet the combined analysis can still fail to identify the few factors that ultimately control project performance. The result may be a large body of information without a clear hierarchy of decisions.

Three recurring problems are particularly important:

First, **influence is often confused with priority**. A sensitivity analysis may identify the variables that have the greatest effect on a model output, but an influential variable is not automatically a practical intervention point.

Second, **uncertainty is often documented without being linked to a decision**. Long lists of data gaps are produced, but insufficient attention is given to whether resolving each gap would materially alter the recommended course of action.

Third, **disciplinary analyses are often insufficiently integrated**. Biological limits may be treated as assumptions in an engineering model, while engineering constraints may be overlooked in agronomic assessments. Financial models may then create an appearance of precision that exceeds the quality of the underlying biological and technical evidence.

FCB Advisory Services developed CDLA in response to these weaknesses. In its application to bioeconomy projects, Bioeconomy-CDLA is designed to move from complexity to clarity, pinpointing where a decision maker can act, what evidence is required, and whether the expected benefit justifies the intervention.

3 Purpose and scope

3.1 Purpose

The purpose of CDLA is to support evidence-based decisions in systems where biological, technical, operational and commercial variables interact.

The framework has five objectives:

1. identify the variables that materially influence project outcomes;
2. distinguish influential variables from actionable decision levers;
3. connect uncertainty and evidence quality to decision risk;
4. prioritise research, engineering and investment activities; and

5. make the basis of strategic recommendations transparent.

3.2 Scope

CDLA is particularly suited to projects involving:

- agricultural production and crop improvement;
- biomass supply, feedstock quantity and quality, and feedstock design;
- renewable fuels and bioproducts;
- harvesting, storage and logistics systems;
- technology evaluation and process integration;
- research and development portfolios;
- feasibility studies and investment appraisal; and
- circular bioeconomy and natural-resource systems.

The framework is most useful when a project contains multiple interacting variables, when evidence is incomplete, or when the organisation must decide where limited time and resources should be directed.

4 What CDLA is—and what it is not, its strengths and limitations

4.1 What CDLA is

CDLA is a structured decision-support framework for identifying the variables, uncertainties and intervention points that materially affect system performance and strategic outcomes.

A **Critical Decision Lever** is a variable or intervention point that satisfies three conditions:

1. it has a material influence on the outcome of interest;
2. it is sufficiently actionable within the technical, financial, operational or regulatory constraints of the project; and
3. changing it, resolving its uncertainty or managing its consequences can alter the preferred decision.

This definition separates a Critical Decision Lever from a merely important variable. For example, rainfall, international commodity prices or regional climate may strongly influence a project but may not be controllable. They may still require scenario analysis or risk management, but they are not necessarily levers. Conversely, a controllable operating parameter may not warrant attention if its effect on overall system performance is negligible.

Its purpose is integration. CDLA uses the outputs of appropriate disciplinary methods and converts them into a transparent hierarchy of decisions, evidence needs and interventions.

4.2 What CDLA is not

CDLA is not:

- a single mathematical model;
- a software platform;
- a substitute for scientific investigation;
- a replacement for engineering design;

- a financial valuation method;
- another name for sensitivity analysis; or
- a claim to have invented systems or decision analysis.

4.3 Focus of contribution

The FCB Advisory Services CDLA Framework does not claim to introduce a new analytical discipline. It draws on established work in systems thinking, systems modelling, sensitivity analysis, uncertainty analysis, scenario analysis, multi-objective decision analysis and evidence-based management. The contribution of CDLA lies in integrating these established foundations into a practical decision-support framework for biological and bioeconomy systems, with explicit emphasis on the distinction between **influence** and **actionability**.

4.3.1 Strengths and limitations

CDLA provides significant value in structuring complex decisions, though its effectiveness remains dependent on underlying evidence quality and clear organizational priorities.

Principal Strengths	Key Limitations
Integrated Evaluation: Synthesises biological, engineering, operational, and commercial evidence into a single decision structure.	**Evidence Dependence:** Quality of outputs is directly constrained by the reliability of supporting data, models, and expert inputs.
Action Focus: Clearly distinguishes highly influential variables from practically actionable levers.	**Subjectivity in Weighting:** Ranking levers requires value judgements (e.g., weighing cost vs. risk vs. time) that vary by decision-maker.
Decision Value of Uncertainty: Directly links data collection and uncertainty reduction to whether it will change a decision.	**Uncertainty Retention:** Does not eliminate inherent system risks or guarantee success of chosen interventions.
Resource Allocation: Directs limited research, capital, and engineering resources to high-impact priorities.	**Boundary Sensitivity:** Poorly defined decision boundaries or omitted variables can lead to skewed priorities.

5 Intellectual and analytical foundations

5.1 Systems thinking

General systems theory established the importance of examining a system as an organised whole rather than as a collection of independent parts (Bertalanffy 1968). System dynamics subsequently provided methods for representing feedback, accumulation, delay and nonlinear behaviour in complex industrial and organisational systems (Forrester 1961; Forrester 1997). Soft Systems Methodology extended systems thinking into situations where the problem itself may be contested or incompletely defined (Checkland 1981).

CDLA adopts the systems principle that project outcomes emerge from relationships among components. It therefore begins with system definition: boundaries, objectives, variables, dependencies, constraints and feedback.

5.2 Systems modelling

A systems model makes assumptions and causal relationships explicit. Depending on the decision, this may involve a conceptual diagram, mass balance, spreadsheet, simulation model, optimisation model, statistical model or integrated digital tool.

Within CDLA, modelling is used to understand how biological, engineering and commercial variables propagate through the system. The purpose is not model complexity for its own sake. The appropriate model is the simplest representation capable of objectively informing the specific decision problem at hand.

5.3 Sensitivity analysis

Sensitivity analysis investigates how variation in model inputs affects model outputs. It can reveal which assumptions dominate a result and where model behaviour is robust or fragile. Global sensitivity analysis is particularly valuable where variables interact or vary simultaneously (Saltelli et al. 2008).

CDLA uses sensitivity analysis as an important analytical input, but does not stop there. High sensitivity indicates influence; it does not establish actionability, feasibility or value. A sensitive variable becomes a candidate Critical Decision Lever only after it is evaluated in its practical context.

5.4 Uncertainty analysis

Uncertainty analysis examines the consequences of incomplete knowledge, measurement error, natural variability and model limitations. In biological systems, uncertainty may arise from seasonal variability, limited local trials, genotype-by-environment interaction, sampling methods or inadequate characterisation of feedstock properties.

Within CDLA, uncertainty is evaluated in relation to the decision. The relevant question is not simply, "How uncertain is this parameter?" but:

> **Could reducing this uncertainty change what we decide to do?**

This leads to a more disciplined approach to verification. Evidence collection is prioritised where it can alter design values, change the preferred option, reduce material risk or prevent inappropriate investment.

5.5 Decision analysis and multiple objectives

Decision analysis provides a formal basis for evaluating alternatives under uncertainty. Work by Howard (1966) and Keeney and Raiffa (1993) established approaches for structuring decisions, clarifying objectives, assessing trade-offs and evaluating uncertain outcomes.

Bioeconomy projects rarely have a single objective. Decisions may involve yield, reliability, quality, cost, emissions, technology readiness, grower acceptance and implementation time. CDLA therefore recognises that a technically optimal option may not be strategically preferred once multiple objectives and constraints are considered.

5.6 Scenario analysis

Scenario analysis considers plausible alternative conditions rather than relying on a single forecast. It is particularly useful where future conditions cannot be assigned reliable probabilities or where structural change may occur. Scenario planning is a means of broadening strategic thinking and testing decisions against multiple possible futures.

CDLA uses scenarios to evaluate the robustness of proposed interventions. A lever that appears attractive only under a narrow combination of assumptions may rank below an intervention that creates value across a wider range of conditions.

5.7 Evidence-based decision-making

Evidence-based management emphasises the disciplined use of the best available scientific evidence, organisational data, professional expertise and stakeholder information (Rousseau 2006). This is closely aligned with FCB Advisory Services emphasis on transparent evidence-based evaluation.

Within CDLA, evidence is assessed not only for relevance but also for confidence. Published data from another region, expert judgement, preliminary trials and validated local measurements do not carry the same evidentiary weight. The level of confidence must be visible in the decision process.

6 The CDLA framework

CDLA can be organised into seven connected stages. The process is iterative rather than strictly linear: new evidence may require the system definition, model or priorities to be revised.

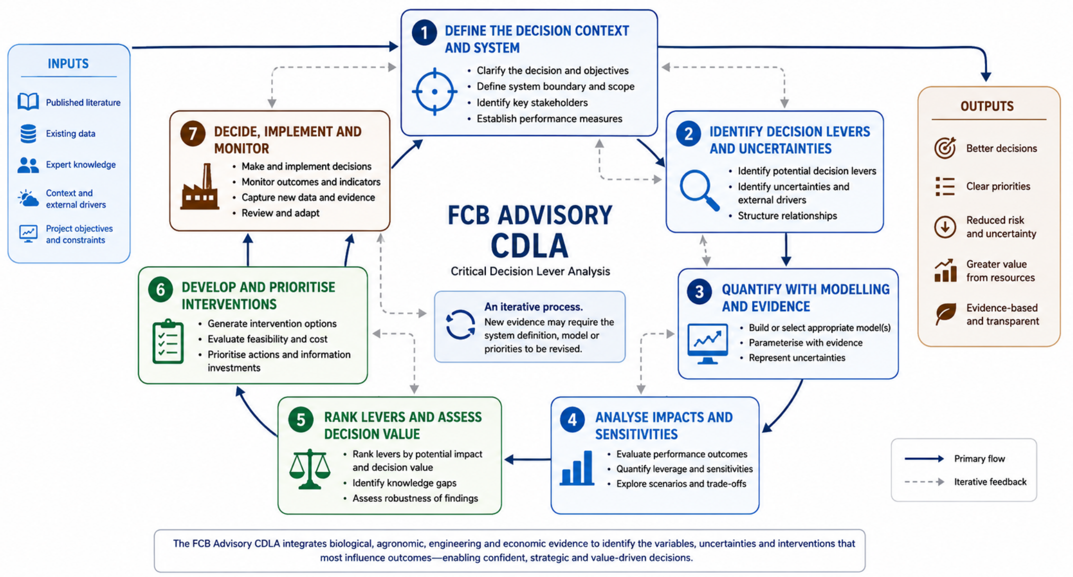

Figure 1: Conceptual workflow of the FCB Advisory CDLA Framework. The final figure should show the seven stages and the feedback from verification to system understanding.

6.1 Define the decision

The analysis begins by specifying the decision that must be made. This includes:

- the decision owner;
- the outcome or outcomes of interest;
- the time horizon;
- the available alternatives;
- the system boundary; and
- the constraints within which action is possible.

A poorly defined decision produces an unfocused analysis. CDLA therefore distinguishes between a broad topic—such as improving biomass supply—and a decision—such as whether to invest in irrigation, alter planting dates or redesign the harvest system.

6.2 Build system understanding

The second stage maps the biological, feedstock, engineering, operational and commercial relationships that determine the outcome. This may include causal diagrams, process maps, material flows, evidence tables and expert workshops.

The purpose is to identify:

- system components;
- dependencies and feedback;
- potential constraints;
- controllable and uncontrollable variables;
- performance measures; and
- points at which uncertainty enters the system.

6.3 Establish the evidence base

Available evidence is compiled and critically evaluated. Evidence may include peer-reviewed literature, experimental data, operational records, commercial information, model outputs and expert knowledge.

For each key parameter, CDLA records:

- the representative value or range;
- the source of evidence;
- relevance to the system and region;
- confidence level;
- known limitations; and
- verification requirement.

This step prevents low-confidence assumptions from becoming hidden facts within subsequent models.

6.4 Quantify influence and uncertainty

Appropriate analytical tools are used to examine how variables influence the outcome. These may include local or global sensitivity analysis, scenario analysis, probabilistic simulation, optimisation, break-even analysis or comparative assessment.

The output is not yet a final ranking. It is an evidence-based description of which variables have material influence, how they interact and where uncertainty affects the result.

6.5 Evaluate actionability and feasibility

Influential variables are then evaluated against practical criteria, including:

- degree of organisational control;
- technical feasibility;
- implementation cost;
- time required;
- regulatory or contractual constraints;
- technology readiness;
- operational risk;
- reversibility; and
- stakeholder acceptance.

This is the stage at which CDLA moves beyond conventional sensitivity analysis.

6.6 Identify and rank Critical Decision Levers

Candidate levers are ranked according to their combined influence, actionability, feasibility, uncertainty and expected value.

The ranking may be qualitative, semi-quantitative or quantitative depending on the evidence available. The method should be proportionate to the decision and transparent to those who will use it.

A useful representation is an influence–actionability matrix. Variables with low influence normally receive limited attention. Variables with high influence but low actionability are treated through risk management, scenario planning or system redesign. Variables with both high influence and high actionability become priority Critical Decision Levers.

6.7 Define verification and implementation priorities

The final stage converts the ranking into action. Depending on the project, outputs may include:

- research and validation priorities;
- engineering modifications;
- operating changes;
- investment sequencing;
- stage-gate criteria;
- risk controls;
- data-collection plans; and
- recommendations to proceed, pause, redesign or terminate.

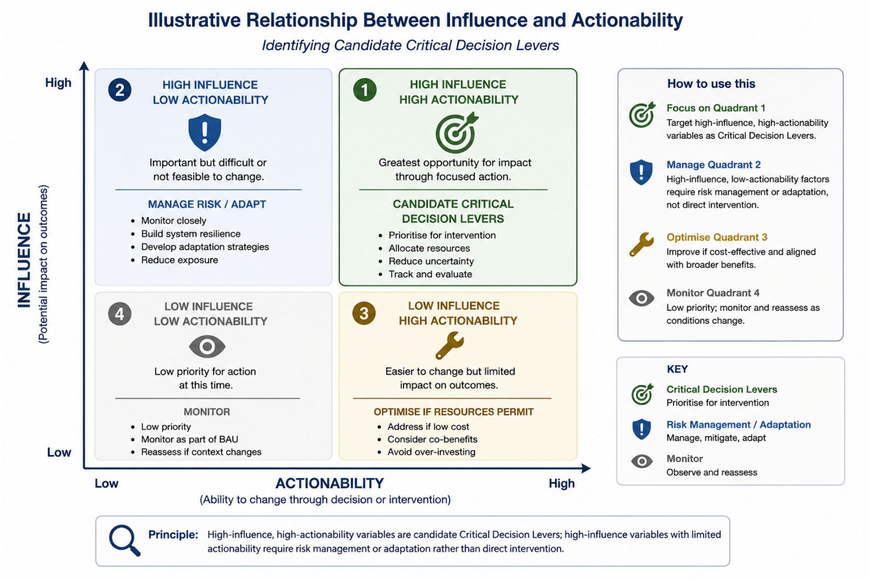

Figure 2: Illustrative relationship between influence and actionability. High-influence, high-actionability variables are candidate Critical Decision Levers; high-influence variables with limited actionability require risk management or adaptation rather than direct intervention.

Verification is prioritised where additional evidence has a realistic prospect of changing the decision. This avoids spending time and money reducing uncertainty that is intellectually interesting but strategically immaterial.

7 Bioeconomy-CDLA: application in the bioeconomy

7.1 Biomass supply systems

Feedstock quantity and quality are fundamental to the technical and commercial viability of any bioeconomy project. Yet both emerge from systems that may contain dozens of interacting variables: planted area, participation rate, crop yield, seasonal conditions, harvest losses, moisture content, bulk density, composition, transport distance, storage loss, ash content and delivered cost.

Sensitivity analysis alone may show that yield and delivered moisture strongly influence annual tonnage and processing performance. Bioeconomy-CDLA goes further by asking whether these variables are actionable, how readily they can be changed, what intervention would cost, and how confidently the expected outcome can be predicted.

Factors such as planting date, cultivar choice, irrigation and harvest timing may influence yield. Moisture may be influenced through harvest scheduling, field wilting, storage management or process design. The costs, constraints and evidence requirements differ for each intervention. Instead of treating all influential variables as equally important, Bioeconomy-CDLA ranks potential interventions according to their influence, actionability, feasibility, uncertainty and expected value in relation to the strategic objective.

7.2 Technology evaluation

A conversion technology may perform well when feedstock properties remain within a narrow range. The critical issue may not be the nominal efficiency of the technology, but whether the feedstock supply system can consistently meet its operating requirements and feedstock specifications.

Bioeconomy-CDLA links feedstock variability, preprocessing requirements, technology tolerance and operating risk. This may reveal that investment in feedstock control creates more value than further optimisation of the conversion process.

7.3 Research prioritisation

Research programmes often contain more possible experiments than can be funded. CDLA can identify which unknowns have the greatest potential to change a design decision or commercial outcome.

A variable with high uncertainty but little influence does not warrant the same priority as a moderately uncertain parameter that determines plant scale, equipment selection or investment viability. This creates a defensible basis for research sequencing.

7.4 Investment and implementation

At the investment stage, CDLA can translate technical analysis into decision gates. For example:

- Which assumption must be verified before capital is committed?
- Which risk can be managed contractually?
- Which variable requires a pilot-scale test?
- Which uncertainty can be accepted without altering the investment decision?
- Which lever offers the highest value from early intervention?

The result is not simply a ranked list of variables, but a practical roadmap for reducing decision risk and improving system performance.

8 Outputs

Depending on the scope of the project, CDLA can be used to produce:

- a system map and defined decision boundary;
- an evidence and assumptions register;
- representative design values with confidence ratings;
- sensitivity and uncertainty results;
- an influence–actionability matrix;
- a ranked register of Critical Decision Levers;
- verification and research priorities;
- an implementation roadmap;
- decision-gate criteria; and
- an executive summary for management, boards or investors.

The outputs should make the reasoning traceable. A reader should be able to understand why a lever was prioritised, what evidence supports the ranking and what action is proposed.

9 Conclusion

Critical Decision Lever Analysis (CDLA), developed by FCB Advisory Services, provides a practical framework for moving from complex technical evidence to focused strategic action. Its principal application in biological and bioeconomy systems is Bioeconomy-CDLA.Critical Decision Lever Analysis (CDLA), developed by FCB Advisory Services, provides a practical framework for moving from complex technical evidence to focused strategic action. Its principal application in biological and bioeconomy systems is Bioeconomy-CDLA.

The framework recognises that many variables may influence a system, but relatively few warrant intervention. A Critical Decision Lever is identified where influence, actionability, feasibility, uncertainty and expected value converge.

CDLA draws openly on established foundations in systems thinking, modelling, sensitivity analysis, uncertainty analysis, scenario analysis and decision analysis. Its contribution lies in integrating these foundations into a practical decision-support framework and in placing explicit emphasis on the distinction between an influential variable and a worthwhile intervention. Bioeconomy-CDLA applies this framework to the interconnected biological, feedstock, engineering, logistics and commercial decisions that characterise bioeconomy projects.

Used appropriately, CDLA helps organisations direct research, engineering effort and investment toward the decisions most likely to improve system performance or reduce material risk.

Acknowledgement of intellectual foundations

The FCB Advisory Services CDLA Framework draws on analytical disciplines developed by many researchers and practitioners over several decades. FCB Advisory Services fully acknowledges these foundations. The framework is presented as an integrated decision-support framework developed by FCB Advisory Services, not as a claim of ownership over the underlying analytical disciplines.

Recommended citation

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