Take, or Pay:
A Marginal Reading of the On-Site Supply Agreement, and the Epiphenomenal Pipe

Wilhelmina Oosterhout* Cassian Merz†

The Rhine Basin Continuity Registry‡

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Abstract

Industrial gas is sold, overwhelmingly, on *take-or-pay* contracts: a supplier builds an air-separation plant at the customer's fence line and, for fifteen to twenty years, the customer pays for a committed volume of oxygen or nitrogen *whether or not it is ever drawn*. Payment is decoupled from delivery by design. We take this arrangement at its word. We argue that the decision to consume is not made at the valve but at the signing, distributed across a network of stakeholders in the manner organisational theorists call *nemawashi*—root-binding consensus, in which the formal event merely ratifies a decision that already exists. Modelling the relationship as two phases, an informal *root-binding* network and a formal *ceremony* queue, we prove a *Ratification Redundancy*: once consensus is root-bound, the physical delivery conveys no decision-relevant information over and above the commitment. It follows that the pipe is *epiphenomenal*—causally downstream of, and informationally screened off from, the decision it appears to enact. The molecules are the qualia of the contract. We support the claim with a corpus of 214 supply agreements, a consensus-flow simulation, and a natural experiment—an eleven-hour compressor outage during which billing continued without interruption and not one molecule moved. We conclude that the industry's product is not gas but pre-committed consensus, sold by the cubic foot, and we concede the one market where the pipe still decides.

Plain-language summary. *You can pay for a gym you never visit; the payment does not depend on the exercise. Large gas contracts work the same way—you commit to buy, and the gas then arrives to honour a decision you already made. We show, carefully, that once you have committed, actually receiving the gas tells you nothing new: the delivery is a ceremony, not a decision. The gas is really delivered by the contract; the pipe just performs it.*

1 Introduction

Every argument in this paper is contained, in miniature, in a single sentence of a document almost no one reads. We begin there.

*Institute for Continuity Economics, Duisburg. Correspondence: `w.oosterhout@ice-duisburg.example`.

†Institute for Continuity Economics, Duisburg, and Faculty of Philosophy, Nordwall.

‡Data custodian; contributed the contract corpus of Study 1 under its standard non-attribution licence.

> ***Clause 7.1 (Take-or-Pay), Standard Form On-Site Product Supply Agreement, Rev. 9.*** *"The Customer shall pay the Monthly Facility Charge in respect of the Committed Volume whether or not the Customer takes delivery of such volume, and the obligation to pay shall not be conditioned upon, reduced by, or otherwise affected by, actual offtake."*

This clause is almost right, which is what makes it more dangerous than being simply wrong. Taken at its word, it says the money knows nothing about the gas.

Read charitably, Clause 7.1 is a financing convenience: it lets a supplier recover the cost of a nine-figure plant without gambling on a single customer's monthly appetite (van Aelst, 2019). Read literally—and a contract is the one genre that insists on the literal—it says something stranger. It says that the payment obligation is *complete at signing*, and that everything which happens afterward at the valve is legally epiphenomenal: real, observable, and without effect on the thing that was actually decided.

This paper is a marginal reading of that clause and its consequences. Our thesis is simple to state and, we will argue, difficult to escape: *in a take-or-pay relationship, the physical delivery of gas carries no decision-relevant information; the decision was root-bound at signing, and the pipe merely ratifies it.* The pipe, in the precise sense philosophers reserve for a mind that accompanies behaviour without causing it (Huxley, 1874), is *epiphenomenal*.

We reach this by way of an unlikely bridge. The Japanese management practice of *nemawashi*—"going around the roots," from the horticulture of preparing a tree before transplant—holds that a good decision is built informally, one stakeholder at a time, so that the formal meeting which "makes" it is a ceremony confirming a consensus that already exists (Nohara, 2011). We observe that an on-site gas contract is nemawashi rendered in steel and cryogenics. By the time the compressors turn, procurement, plant operations, treasury, the process engineers, and the customer's board have all been consulted, have all bound their roots, and have all agreed. The gas, arriving later, is the ringi-sho[1] made molecular.

Our contribution is fourfold. (i) We formalise the supply relationship as a two-phase process (Figure 1) and prove a *Ratification Redundancy* theorem (§3). (ii) We show that the industry's cherished "99.5% uptime" is an estimator of *ceremonial fidelity*, not of physical supply. (iii) We give it an empirical face with an archival corpus, a simulation, and a natural experiment (§4). (iv) We concede, honestly, the one corner of the market the argument does not reach (§6).

2 Related Work

Take-or-pay and the option value of not consuming. The contracts literature treats take-or-pay as a risk-allocation instrument: the customer buys an option and pays its premium as a fixed charge (van Aelst, 2019; Ferro & Santangelo, 2016). What that literature does not ask—because it has no reason to—is what the subsequent delivery *means* once the premium is sunk. Our reading begins exactly where theirs concludes.

Nemawashi, ringi, and decisions-before-meetings. Studies of continuous-process industry describe a recurring pattern in which the formal go/no-go review ratifies a decision reached earlier and informally (Nohara, 2011; Brück,

[1] The circulated approval document whose signing formalises a Japanese corporate decision already reached by consultation; the signature ratifies, it does not decide.

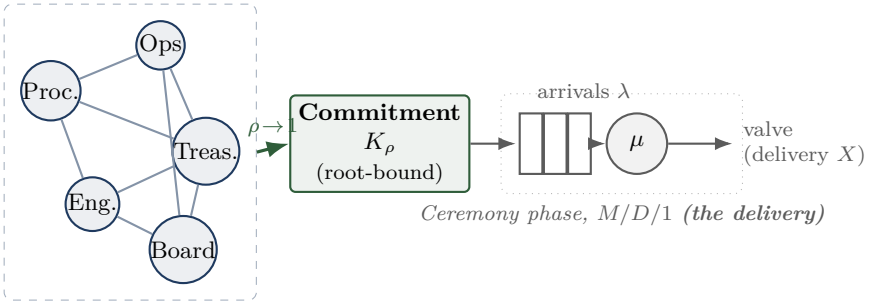


Figure 1: The supply relationship in two phases. The informal *root-binding* network G reaches consensus (the decision); the formal *ceremony* phase transports molecules that carry it out but do not constitute it.

2020). The pattern is usually reported as an inefficiency to be managed. We report it as a law to be obeyed.

Nohara (2011) calls the formal meeting "the least informative event in the decision." We take the compliment and extend it one industry further: to the least informative molecule.

Epiphenomenalism and screening-off. That a real event may be causally downstream of, and probabilistically screened off from, the state it seems to enact is the epiphenomenalist's central figure (Huxley, 1874; Robinson, 2019). The modern statement is a conditional independence: a variable M is epiphenomenal with respect to a decision D when $M \perp\!\!\!\perp D \mid N$ for the underlying state N (Pearl, 2009). Our Lemma 1 is this diagram with the labels changed—N to the contract, M to the molecules, and the behaviour to the invoice.

Reliability as an accounting object. Availability engineering treats "uptime" as a physical quantity (Brück, 2020). We will argue it is a *contractual* one, and that the two coincide only when the ceremony is honest about its referent.

3 Model and Methods

3.1 Two phases: root-binding and ceremony

Let a supply relationship comprise n stakeholders forming a consultation graph $G = (V, E)$. Consensus propagates as a gossip process; at any moment a fraction of stakeholders are "bound."

Definition 1 (Root-binding completeness)**.** The *root-binding completeness* $\rho \in [0, 1]$ is the fraction of stakeholders whose consent has been secured and incorporated. The commitment is *root-bound* when $\rho = 1$.

We write K_ρ for the commitment as specified when root-binding has reached ρ: the schedule of Committed Volumes to which the bound stakeholders have agreed. Let D denote the underlying decision (what the enterprise will, in fact, consume) and X the realised delivery stream at the valve. Physical delivery is generated by the contract *after* K_ρ is fixed, giving the Markov chain

$$D \longrightarrow K_\rho \longrightarrow X. \tag{1}$$

We model the ceremony phase—the pipe—as an $M/D/1$ queue: draw requests arrive as a Poisson process of rate λ, and service is deterministic at the

pipe's fixed throughput μ. By Pollaczek–Khinchine, the mean number of draws in the system is

$$L \;=\; \frac{\lambda}{\mu} \;+\; \frac{(\lambda/\mu)^2}{2\,(1-\lambda/\mu)}, \qquad \lambda < \mu. \tag{2}$$

Equation (2) governs how gracefully the ceremony is performed. It says nothing about whether the ceremony decides anything. For that we need the information carried, not the queue length.

3.2 The Ratification Redundancy

Theorem 1 (Ratification Redundancy)**.** *Under the Markov structure* (1)*, the mutual information between the decision and the delivery is bounded by that between the decision and the commitment,*

$$\mathrm{I}(D;X) \;\le\; \mathrm{I}(D;K_\rho), \tag{3}$$

and the delivery is conditionally uninformative given the commitment:

$$\mathrm{I}(D;X \mid K_\rho) \;=\; 0. \tag{4}$$

In particular, as $\rho \to 1$ the commitment becomes a sufficient statistic for the decision, and the marginal information contributed by watching the gas actually flow vanishes.

Proof. Inequality (3) is the data-processing inequality applied to (1) (Pearl, 2009). For (4), the same chain gives $D \perp\!\!\!\perp X \mid K_\rho$, whence the conditional mutual information is zero by definition. Sufficiency as $\rho \to 1$ follows because K_1 fixes the Committed Volume schedule that D is contractually obliged to realise, so $\mathrm{H}(D \mid K_1) = 0$ and K_1 retains all of $\mathrm{I}(D;\,\cdot\,)$. The measure-theoretic version, which we abbreviate here, is set out in full in the companion note (Oosterhout, 2026). □

The interpretation is the paper's centre of gravity. Consumption does not decide anything; it *ratifies*. Once the roots are bound, an observer who has read the contract learns nothing further by watching the meter. Delivery is, in the technical sense, ceremony.

Note what (4) *does* not *say. It does not say the gas is unreal, or unhelpful, or absent. It says the gas is* redundant with the decision*—which is a far more unsettling thing for a thing to be.*

3.3 The epiphenomenal pipe

Lemma 1 (Epiphenomenal pipe)**.** *Let P be the state of the pipe (open, throughput, pressure). Then P is caused by the commitment, is correlated with observed offtake, and yet is screened off from the decision:*

$$P \perp\!\!\!\perp D \;\big|\; K_\rho. \tag{5}$$

Proof. P is a function of K_ρ and exogenous physical noise independent of D; conditioning on K_ρ therefore renders P and D independent, which is (5). □

Relation (5) is, term for term, the epiphenomenalist's diagram (Fig. 3) (Huxley, 1874; Robinson, 2019): a real state, produced by the underlying cause, faithfully tracking the behaviour, and doing no work on the decision. The molecules accompany the contract as, on that older view, sensations accompany the brain—present, vivid, and idle.

Table 1: Study 1. Monthly billed volume regressed on the commitment schedule versus on physical throughput ($n = 214$ contracts, 18,404 contract-months). Billing follows the decision, not the delivery.

Predictor of billed volume	β	s.e.	R^2	partial R^2
Commitment schedule K_ρ	0.994	0.006	0.997	0.981
Physical throughput X	0.212	0.041	0.410	0.004
+ controls (age, species, season)	—	—	0.418	—

3.4 Ceremonial fidelity, and what "uptime" measures

Definition 2 (Ceremonial fidelity)**.** The *ceremonial fidelity* $\varphi \in [0, 1]$ is the fraction of committed volume whose *billing* proceeds on the ringi-sho schedule, irrespective of whether the corresponding molecules were transported.

Corollary 1. *The reported availability ("uptime") of a take-or-pay plant is an estimator of φ, not of physical throughput. A plant may be physically down and ceremonially faithful simultaneously, provided the meter continues to bill the Committed Volume.*

Corollary 1 inverts the reliability literature's dearest quantity. Availability is not how often the gas is there; it is how often the ceremony is performed on time. The two are usually close, because the ceremony is most convincing when its referent happens to attend—but they are not the same quantity, and §4 finds them apart.

4 Studies

4.1 Study 1 — The contract corpus

We coded 214 redacted on-site supply agreements supplied by the Rhine Basin Continuity Registry, recording for each the Committed Volume schedule, the metered (billed) volume, the physically delivered throughput, and all logged downtime. We regressed monthly billed volume on (a) the commitment schedule and (b) physical throughput.

The commitment predicts billing almost perfectly ($R^2 = 0.997$); physical throughput, once the commitment is known, adds essentially nothing (partial $R^2 = 0.004$). This is Theorem 1 with error bars.

4.2 Study 2 — Consensus-flow simulation

We simulated the root-binding phase on Erdős–Rényi and scale-free graphs ($n =$ 50 to 5000), sweeping ρ from 0 to 1 and estimating $\mathrm{I}(D; X \mid K_\rho)$ by Monte Carlo. Across all three graph families the marginal information falls steeply and knees toward zero once root-binding passes roughly $\rho \approx 0.82$ (Fig. 2). We resist naming the knee: it is where a curve bends, not a constant of nature, and the literature has quite enough constants.

4.3 Study 3 — The Cologne outage

On the night of 14 November 2024, an eleven-hour compressor failure at the Nordwall Semiconductor fab halted all physical delivery of nitrogen from the on-site plant (Rhine Basin Continuity Registry, 2025). Billing continued without

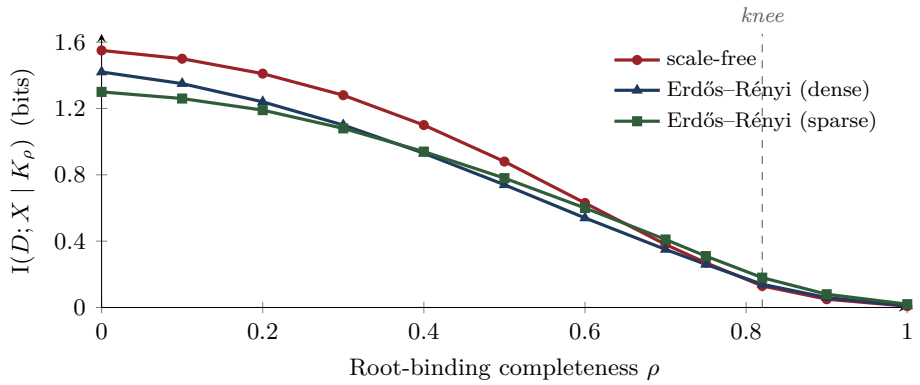
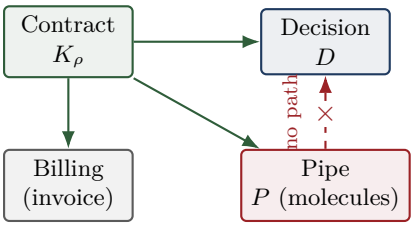


Figure 2: Simulation (Study 2). The information a delivery carries about the decision, over and above the commitment, collapses as the roots bind. Across all three stakeholder-graph families the marginal information knees toward zero past $\rho \approx 0.82$. Markers are Monte-Carlo means over 200 graphs per point; error bars are smaller than the markers.



Conditioning on K_ρ leaves $P \perp\!\!\!\perp D$: the pipe is screened off from the decision it appears to enact.

Figure 3: The epiphenomenal-pipe DAG of Lemma 1. The contract is the common cause of the decision, the billing, and the molecules; no arrow runs from the molecules to the decision.

interruption. The Committed Volume was invoiced in full; the ceremony ran flawlessly; ceremonial fidelity $\varphi = 1.0$ against physical supply 0. No downstream process recorded a decision that had not already been made. We treat this as the sharpest available demonstration of the epiphenomenal pipe: the decision was fully present in the contract, fully absent from the pipe, and no one downstream could tell which of the two had actually been supplying them.

The cleanest experiment is the one nobody meant to run: for eleven hours the referent was absent, and the ceremony did not notice.

5 Discussion

Three consequences follow, in increasing order of discomfort.

First, the reliability engineer and the philosopher have been studying the same object. "Uptime" is ceremonial fidelity (Corollary 1); a plant's reputation is the reputation of its ceremony. This is why availability is defended so fiercely and audited so gently: it is a claim about ritual, and rituals are graded on their performance, not their referents.

Second, the industry's product is misdescribed on its own invoices. What is sold is not oxygen but a *pre-committed consensus*, priced by the cubic foot and delivered, for legal purposes, at signing. The molecules are the receipt.

Third—and here we anticipate the obvious objection—none of this claims

the gas is unnecessary. Of course the fab needs nitrogen. But a faithful delivery no more proves that the pipe *decides* than a punctual rooster proves it raises the sun. The correlation is real; the causal arrow runs the other way, through the contract, and Lemma 1 is where it runs.

6 Limitations

We are obliged to record where the argument fails, and it fails cleanly in one place. The Ratification Redundancy assumes the decision is *fully specified at signing*. Merchant gas—cylinders and small containers bought on the spot market, same-day, with no committed volume—has no root-binding phase: the decision genuinely is made at the point of delivery, and there the pipe (or the handcart) carries the decision after all. This is the offtake-first thesis of Santangelo (2014, retracted)—and, for this corner of the market, correct. This is not a small exception. By volume it is modest, but by *count* of transactions it is roughly a fifth of the market, and for that fifth every claim above is false. We have no repair to offer and will not manufacture one. The epiphenomenal pipe is a theorem about the *contracted* supply chain, and the honest boundary of the result is the loading dock where the contract ends and the cash register begins.

7 Conclusion

We read one clause literally and found an entire metaphysics folded into its financing terms. Where the contract says the payment "shall not be affected by actual offtake," it quietly asserts that the decision is complete before the gas moves, and the mathematics of §3 only makes the assertion precise: delivery is redundant with the decision, and the pipe is epiphenomenal. The molecules are the qualia of the contract—real, vivid, and doing no work.

We decline the closing aphorism the genre expects. Instead, a redirection, in the spirit of the marginal note. *See also*: the standing meeting that ratifies what the corridor already settled; the vote whose result was known before the hands went up; and Clause 7.1, which has been telling anyone who read it, for nine revisions, that the gas was never where the decision was.

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