BERNSTEIN
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U.S. Multi Industry & Electrical Equipment

Data Center Cooling Equipment: What is the service tail of a CDU (Coolant Distribution Unit)?



Varun Govindaraj
+1 917 344 8543
varun.govindaraj@bernsteinsg.com



Chad Dillard
+1 917 344 8469
chad.dillard@bernsteinsg.com



Alasdair Leslie
+44 20 7762 4952
alasdair.leslie@bernsteinsg.com

Specialist Sales



Steve Song
+1 917 344 8401
steve.song@bernsteinsg.com

A common question we receive from investors is around the robustness of the service tail of liquid cooling equipment (e.g., CDUs). This is a tough one to answer reliably, given in most cases CDUs haven't really been installed and operated at scale in data centers for more than a few years. However, chillers have been, and we can use them as a proxy to estimate annual cashflows. Our key takeaways are laid out below.

Our main finding is that **CDUs do not have near the service tail that larger heat rejection equipment like chillers do.** Over a ~25 year period, we compared the revenue and margin multiple on initial capex revenue / operating profit for both a chiller and CDU. We sized three revenue streams when doing this. First, there is maintenance revenue (we assume this only kicks in 2 years after new equipment is installed to account for a warranty period). Second, there is parts / labor from repair; we assume this only kicks in ~5 years after new equipment is installed. This could be modeled with more precision, but we don't think it changes our answer. Third, there are upgrades / retrofits (in the case of a chiller) or replacement equipment sales (in the case of a CDU which have useful lives <25 years).

For chillers, **the present value revenue multiple on initial capex is ~4x**. Trane has talked about an 8 - 10x revenue multiple which is on undiscounted cashflows. The **operating margin multiple naturally skews higher at ~6x** for the service tail since service revenues happen at higher margins vs. initial capex for new equipment. We assume new equipment operating margins of ~15% and service operating margins of ~25%.

For a CDU (assuming a ~10 year useful life), we estimated a **revenue multiple over the same period of ~3.6x** (not that different from a chiller) but an operating margin multiple of closer to **~3x which is half what we see for a chiller**. This is primarily driven by the fact that equipment changes that happen at the end of a CDUs useful life take place at much lower equipment margins than what we see today. We believe that CDU equipment margins are elevated (and will continue to be elevated) for as long as we see innovation in the underlying GPUs / ASICs which forces liquid cooling equipment to also evolve - however, when these start to stabilize (which doesn't seem to be happening in the next couple of years), **we think new CDU equipment will have a much weaker margin profile** (closer to ~10 - 15% new equipment operating margins vs. 20%+ today).

For investors, we do not think there is a near-term implication here. GW adds continue to dominate the story, and we think they will take place at elevated operating margins for new equipment. However, if you are looking at names to own over a 5+ year period OR looking for downside protection if GW addition slows, **we do think that chiller OEMs look more attractive given a service tail multiple that is twice what we see with CDUs**.

Note that we're still in early days on truly understanding what the service tail opportunity is for liquid cooling equipment. We've assumed maintenance and repair take place at similar rates to chillers, but if it is higher or CDUs are able to command higher service margins, economics do shift more in their favor. Our model is available here for investors to recreate this analysis using their own assumptions.

See the Disclosure Appendix of this report for required disclosures, analyst certifications and other important information. Alternatively, visit our Global Research Disclosure Website.

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BERNSTEIN TICKER TABLE

			5 Oct 2026		TTM	Adjusted EPS				Adjusted P/E (x)	
Ticker	Rating	Cur	Closing Price	Price Target	Rel. Perf.	Cur	2025A	2026E	2027E	2025A	2026E	2027E
VRT (Vertiv)	O	USD	253.62	368.00	42.6%	USD	4.20	6.60	9.06	60.4	38.4	28.0
NVT (nVent)	O	USD	167.17	229.00	55.2%	USD	3.34	5.15	6.55	50.0	32.5	25.5
TT (Trane)	O	USD	470.76	575.00	(4.8)%	USD	13.06	15.28	17.79	36.0	30.8	26.5
CARR (Carrier)	M	USD	55.73	78.00	(22.3)%	USD	2.57	2.85	3.29	21.6	19.5	16.9
JCI (Johnson Controls)	O	USD	156.85	190.00	28.4%	USD	3.78	5.09	6.35	41.5	30.8	24.7
SU.FP (Schneider)	O	EUR	272.80	350.00	(1.7)%	EUR	8.43	10.42	13.24	32.4	26.2	20.6
ABBN.SW (ABB)	M	CHF	81.70	80.00	28.3%	USD	2.56	2.99	3.60	38.4	32.9	27.3
LR.FP (Legrand)	O	EUR	143.10	170.00	(10.8)%	EUR	5.22	6.13	6.86	30.1	25.3	22.4
ETN (Eaton)	O	USD	432.60	534.00	0.1%	USD	12.07	13.45	16.37	35.8	32.2	26.4
SPX			7,773.95									
EDME			1,571.89									

O - Outperform, M - Market-Perform, U - Underperform, NR - Not Rated, CS - Coverage Suspended

LR.FP valuation is Reported P/E (x);

Source: Bloomberg, Bernstein estimates and analysis.

INVESTMENT IMPLICATIONS

We rate VRT Outperform, TP $ 368

We rate NVT Outperform, TP $ 229

We rate TT Outperform, TP $ 575

We rate CARR Market-Perform, TP $ 78

We rate JCI Outperform, TP $ 190

We rate ETN Outperform, TP$ 534

We rate Schneider Outperfrom, TP € 350

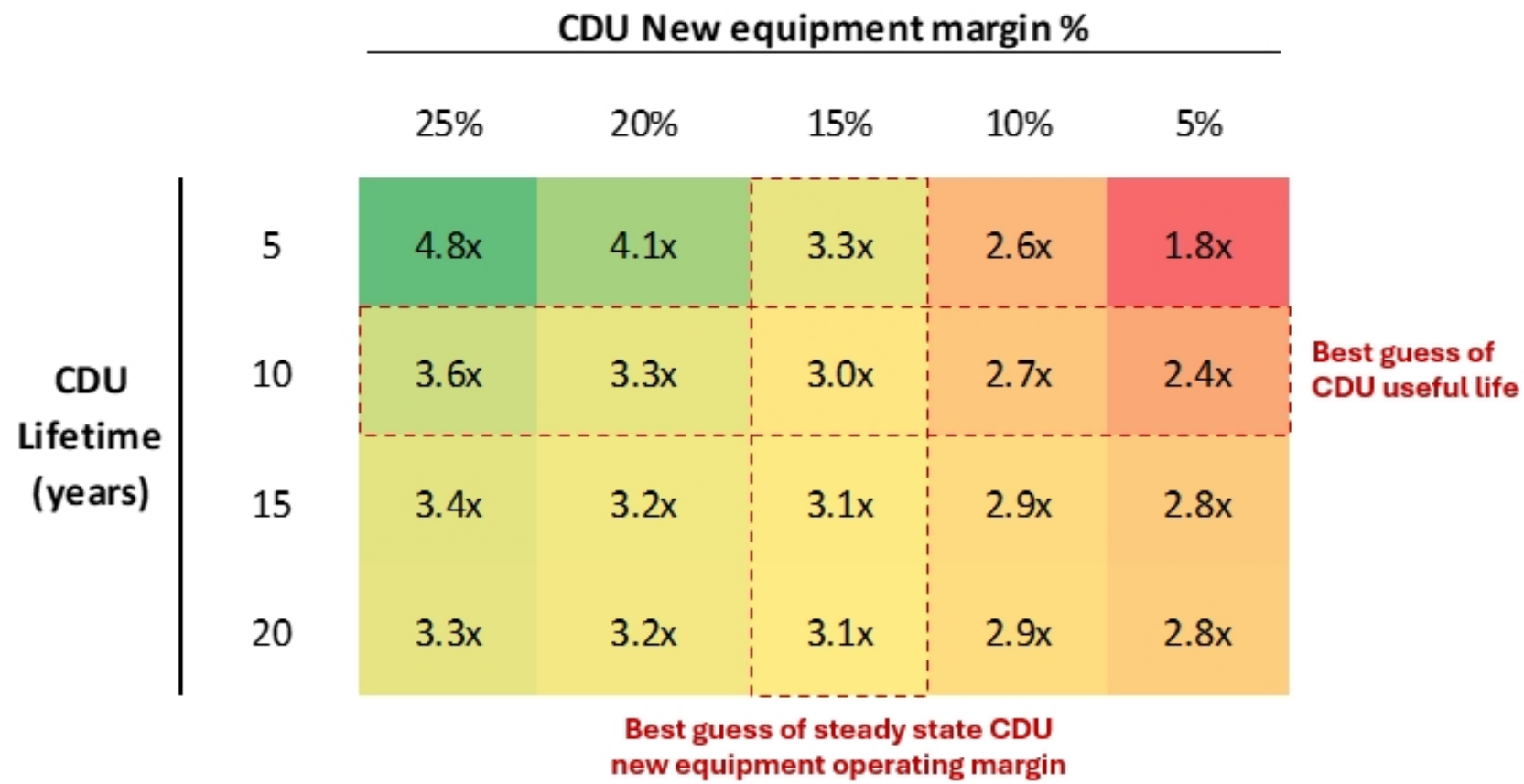
We rate ABB Market-Perform, TP CHF 80

We rate Legrand Outperform, TP € 170

Varun Govindaraj +1 917 344 8543 varun.govindaraj@bernsteinsg.com

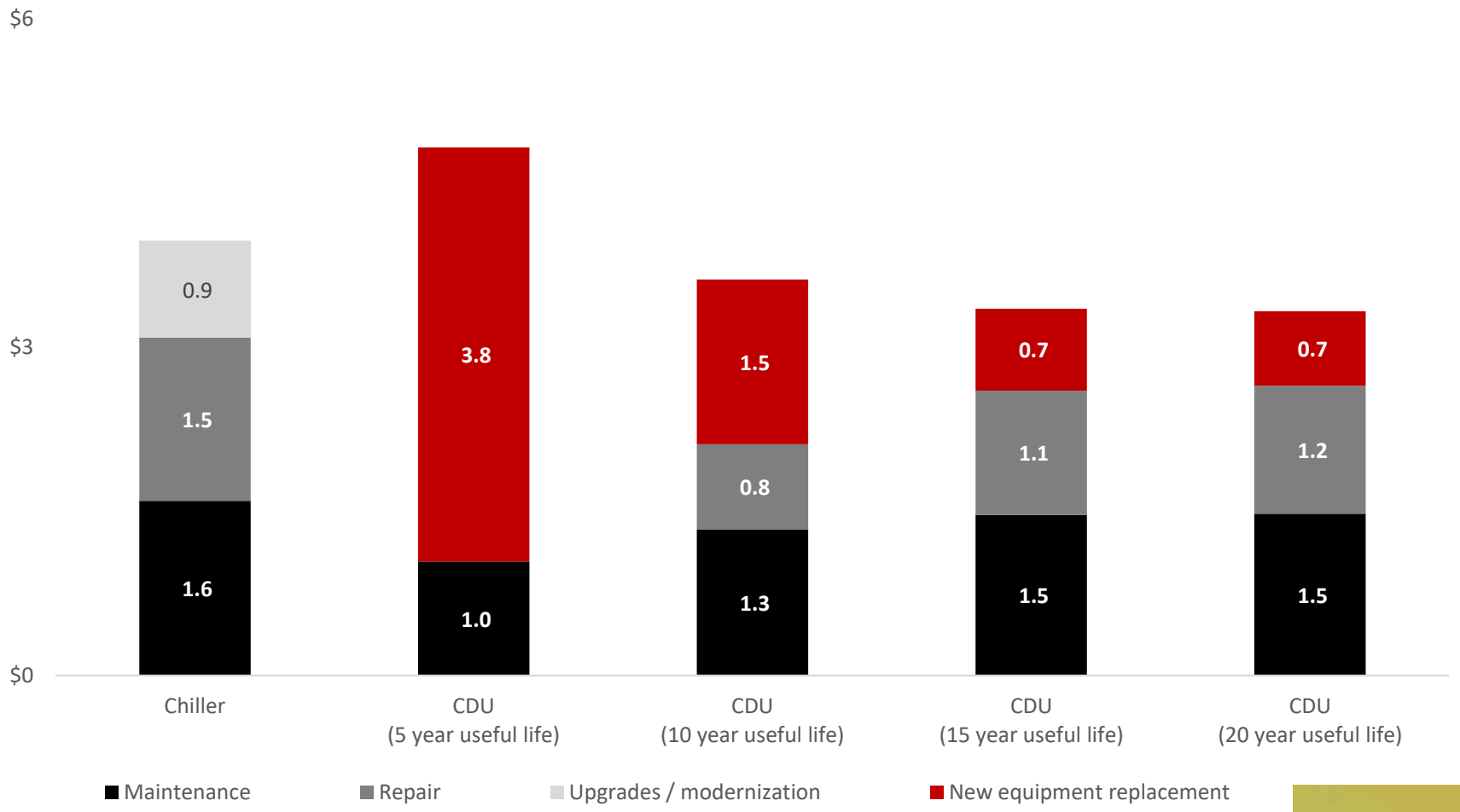
DETAILS

EXHIBIT 1: **CDU operating profit margin multiple over ~25 years (vs. initial equipment sale @ 25% margin); chillers are at ~6x**



Source: Bernstein Analysis and Estimates; Expert Interviews

EXHIBIT 2: **Decomposition of revenue streams after initial capex over a 25 year period (for every $1 of capex revenue)**



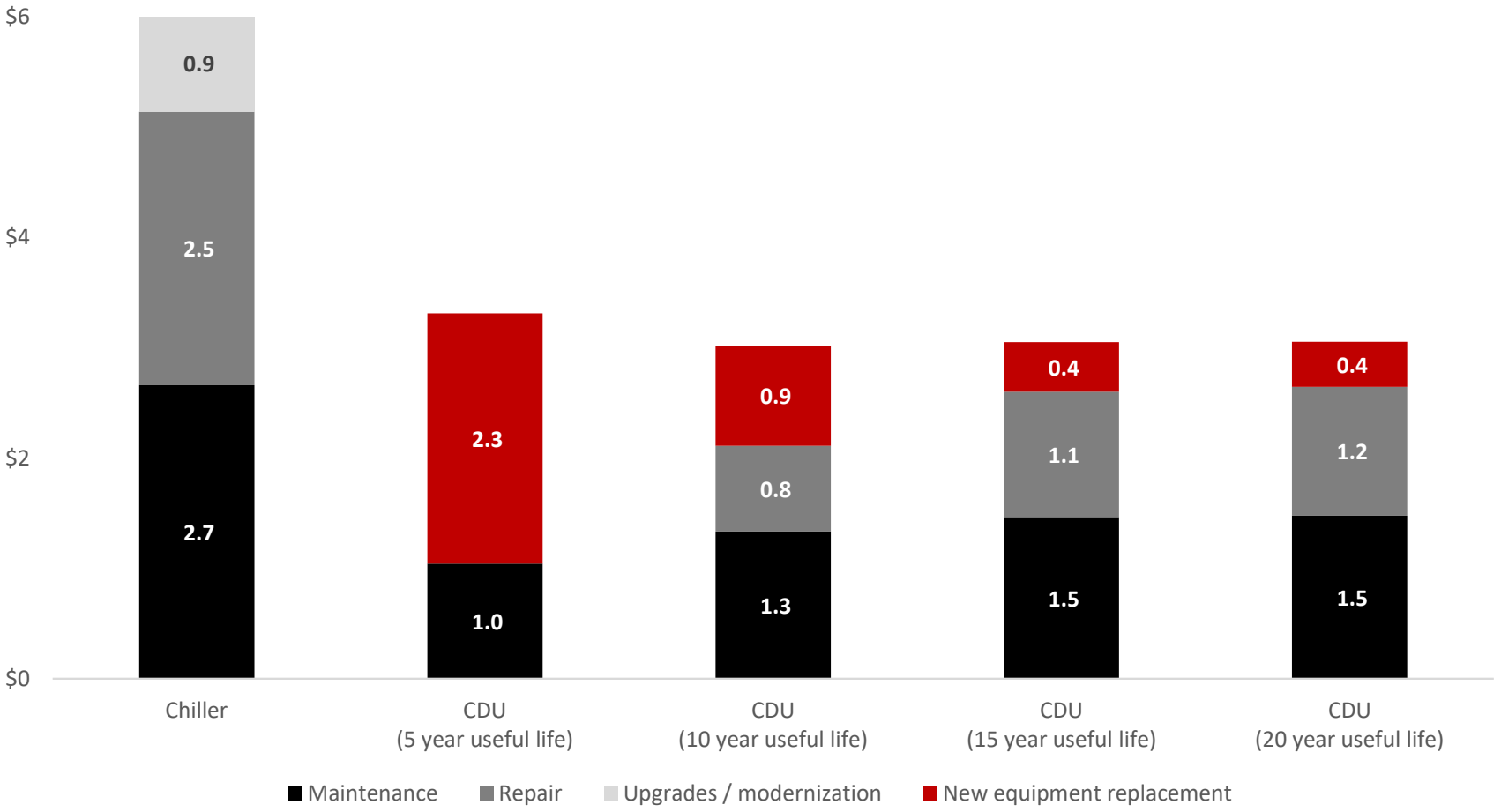
Source: Bernstein Analysis and Estimates, Expert Interviews

Varun Govindaraj +1 917 344 8543 varun.govindaraj@bernsteinsg.com

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Varun Govindaraj +1 917 344 8543 varun.govindaraj@bernsteinsg.com

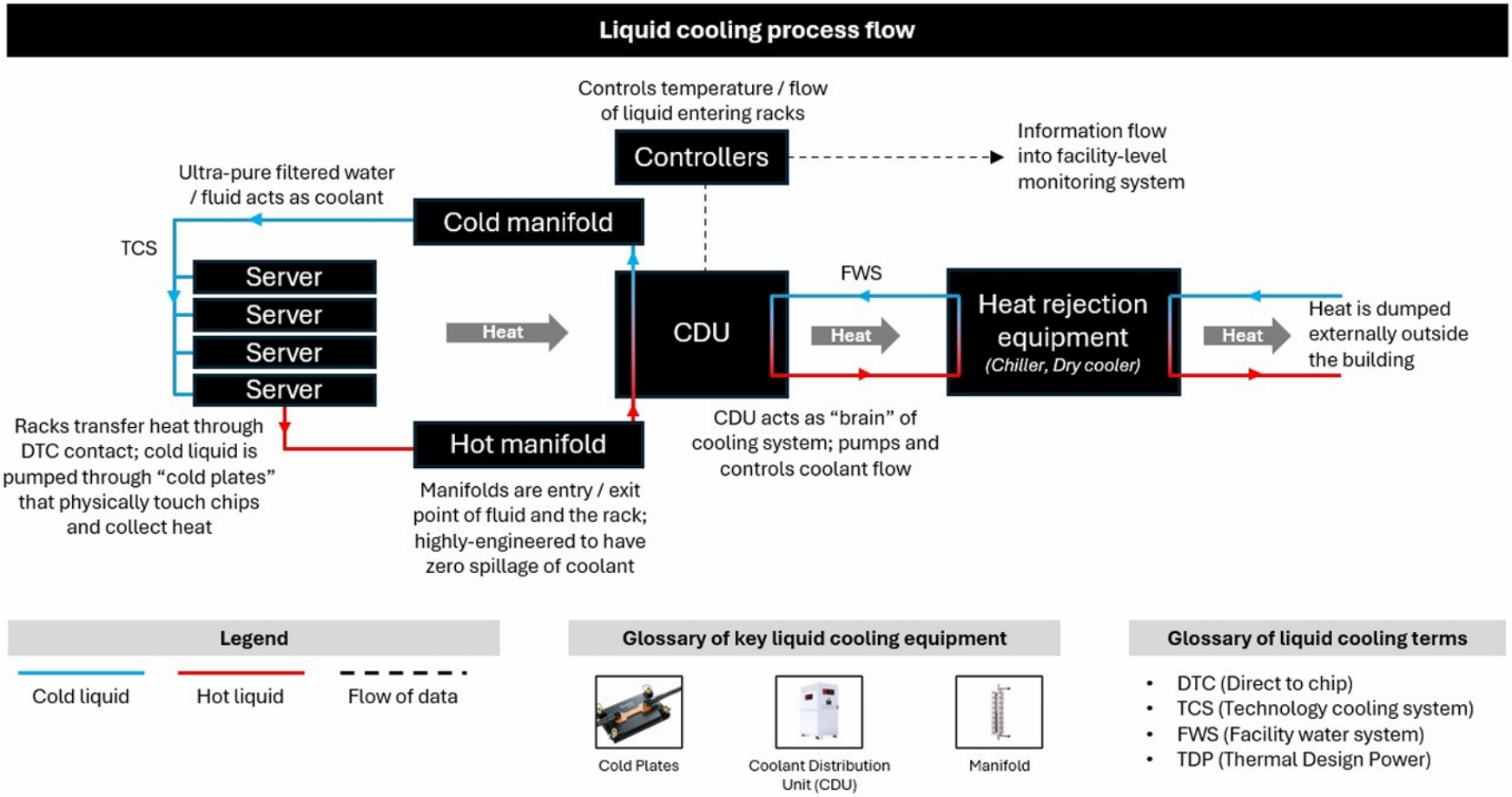
EXHIBIT 3: **Decomposition of operating profit margin streams after initial capex over a 25 year period (for every $1 of capex operating profit) at ~15% CDU new equipment margin**



Source: Bernstein Analysis and Estimates, Expert Interviews

Varun Govindaraj +1 917 344 8543 varun.govindaraj@bernsteinsg.com

EXHIBIT 4: **Recap: Liquid Cooling Overview**



Source: Bernstein Analysis, Company Reports

METHODOLOGY AND FINDINGS

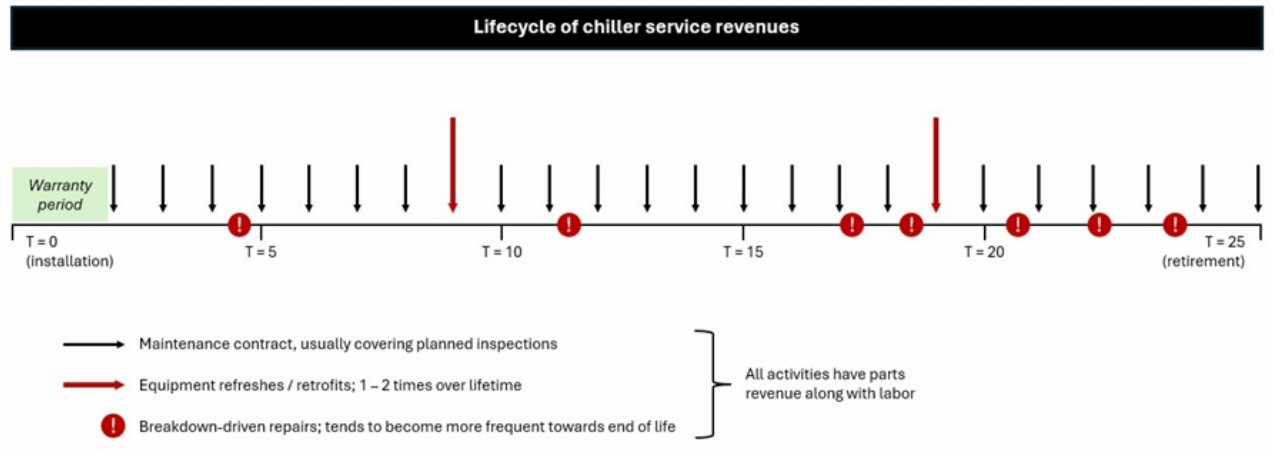
A common question we receive from investors is around the service opportunity of a CDU and whether equipment manufacturers can truly extract value once the equipment has been sold. It is challenging to definitively answer this, however, we can use chillers (where the service tail is better understood) to develop at least a rough estimate. We will not pretend like these numbers are set in stone; however, we do think this offers a framework for investors to use and test with their own assumptions.

As a starting point, we need to understand what the service tail of a chiller looks like. Trane often uses a ~8 - 10x revenue multiple on initial capex (on undiscounted cashflows) as the service tail over the course of ~25 years (the useful life of a chiller). We use the lower end of that number when coming up with our opportunity sizing. This multiple can be broken up into three key components.

- First, there is maintenance, which largely involves checks of the equipment by technicians at planned intervals. We estimate this is ~40% of the total opportunity, starting ~2 years after the equipment is installed (once the warranty period ends).
- Then, we have repair (parts + labor) which also accounts for ~40% of the total opportunity. We estimate this starts ~5 years after the equipment has been installed and continues till the end of life of the equipment. While we have assumed this to be a straight-line recognition, in reality it will likely be lumpier and more weighted towards the back half of the chiller's life, but we do not think that level of precision materially changes our answer and takeaways.
- Finally, for a chiller, we have ~2 upgrades or retrofits over the course of the life of the equipment (once around 8 years and once around 16 years after the unit has been installed), each adding around ~10% of the aftermarket opportunity. We had earlier heard that this could be split roughly a third for each maintenance, revenue, and upgrades, however, that does not seem to make sense as it implies upgrades are roughly equal to new equipment capex (which seems too high). To account for this, we have adjusted our share of value going to upgrades downward and re-allocated that to maintenance and repair.

When we discount these cashflows at ~5% we can estimate that the present value of all revenue cashflows (maintenance, repair, and upgrades) for a **chiller are ~4x the initial installed capex**. We can similarly calculate the "operating margin multiple" (defined as operating margin from initial capex vs. operating margin from the tail), **which we estimate to be ~6x for a chiller over the 25-year life**. This is higher than the revenue multiple since new equipment sales for a chiller take place at ~15% operating margin vs. most service cashflows which take place at closer to ~25% operating margin.

EXHIBIT 5: **What drives service revenue for chillers?**



Source: Bernstein Analysis, Expert Interviews

Next, we replicate this process for a CDU, where we look at the opportunity over a 25 year period once the initial equipment has been installed (to ensure an apples-to-apples comparison with a chiller). We have three similar components to the tail.

- First, there is maintenance revenue. Like with a chiller, we assume this shows up ~2 years after the new equipment has been installed and assume it is the same % of initial capex as a chiller.

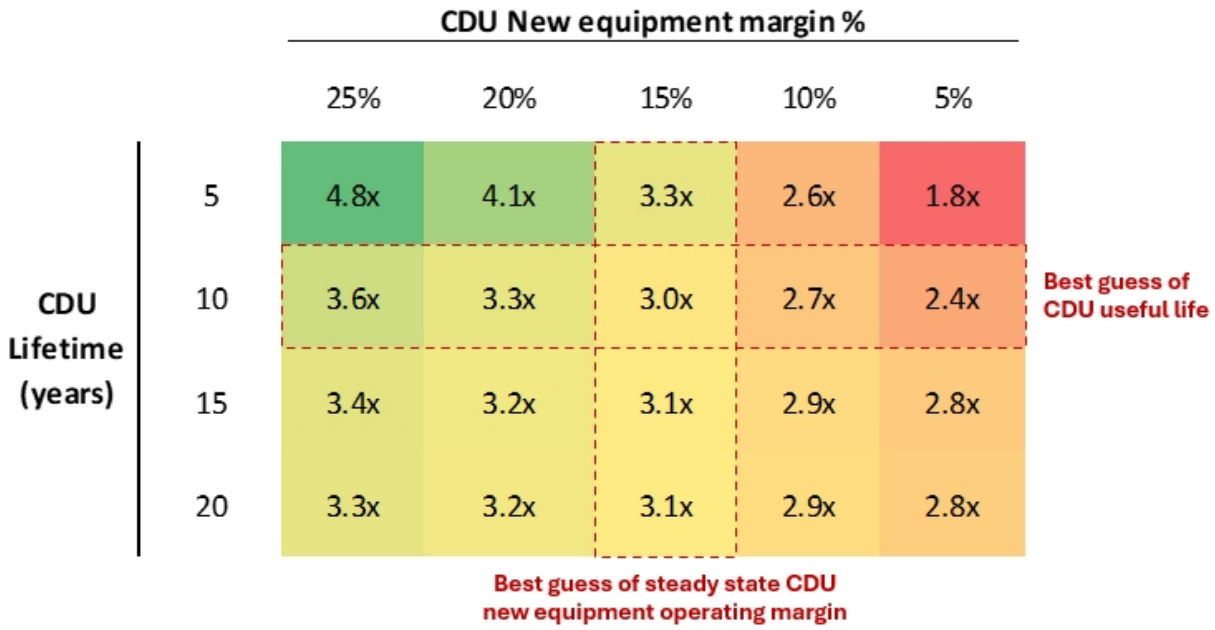
- Second, we have maintenance revenue which we also assume kicks in only after ~5 years and offers an annual revenue potential at a similar % of initial capex as chillers.

- Third, we have equipment replacement (not upgrades) at the end of a CDUs useful life. CDUs do seem to have less longevity vs. chillers so over the course of a ~25 year period (the life of a chiller), we would likely see a CDU be replaced one or more times. This will likely take place in the future at lower operating margins (<15%) as supply catches up with demand and as GPUs / ASICs stop seeing material improvements between generations (which means white space cooling equipment also needs to evolve less and so loses the ability to charge premium margins). While we do not anticipate this to happen before 2030, it does imply that equipment margins for components like CDUs in North America (which are currently elevated) will normalize closer to the low to mid-teens range as we have seen take place with manufacturers in Asia.

Based on a 10 year CDU useful life, **we estimate the revenue multiple at ~3.6x initial capex over a 25 year period** (vs. 4x for a chiller) and **an operating margin multiple of ~3x** (vs. 6x for a chiller). We have also run a sensitivity analysis on what this could mean for CDUs at different useful lives as well as different new equipment margins. A backup excel can be downloaded here for investors that want to adjust this analysis with their own assumptions.

Note that the multiples laid out above, especially for CDUs may also be overstated. Our analysis assumes that all service revenue accrues to the initial OEM once equipment has been installed, as does re-installation of any equipment that reaches the end of its useful life (e.g., a CDU with a 10-year useful life is replaced twice in a 25-year period and we assume that there is no change of OEM). We believe that service attach rates for OEMs will be very high for anything in a data center, and so even though service contracts only have a 2 - 3 year duration, customers will continue to renew them with OEMs since the cost savings of using a 3P will pale in comparison to the risk of a rack burning out. However, in cases where the equipment itself needs to be replaced (which is relevant only to CDUs, not to chillers) we think there is a real risk that data center operators switch one CDU brand out for another **IF** these products get standardized over the next decade (which we expect will happen) - which reduces new equipment as well as service revenues. The shorter the life of a CDU, the more material this risk becomes (since the OEM needs to survive more refresh cycles). This is less of an issue for chillers since we know the life of the equipment is 20+ years.

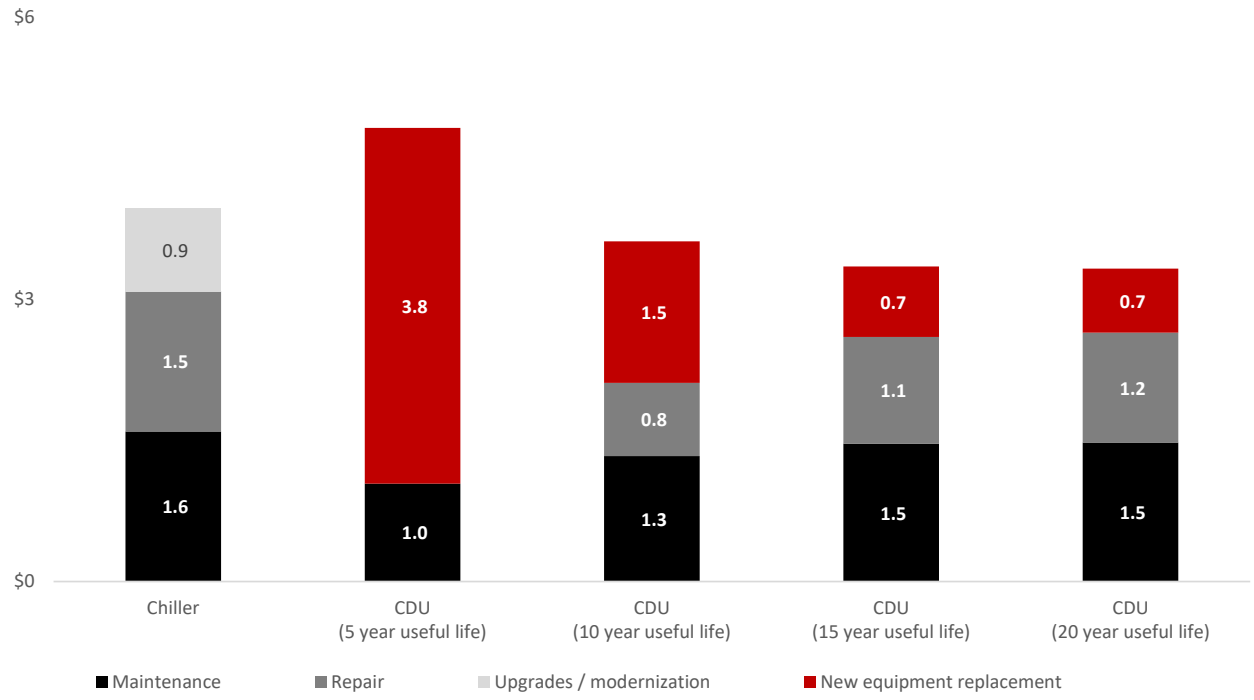
EXHIBIT 6: **CDU operating profit multiple over ~25 years (vs. initial equipment sale @ 25% margin); chillers at ~6x**



Source: Bernstein Analysis and Estimates, Expert Interviews

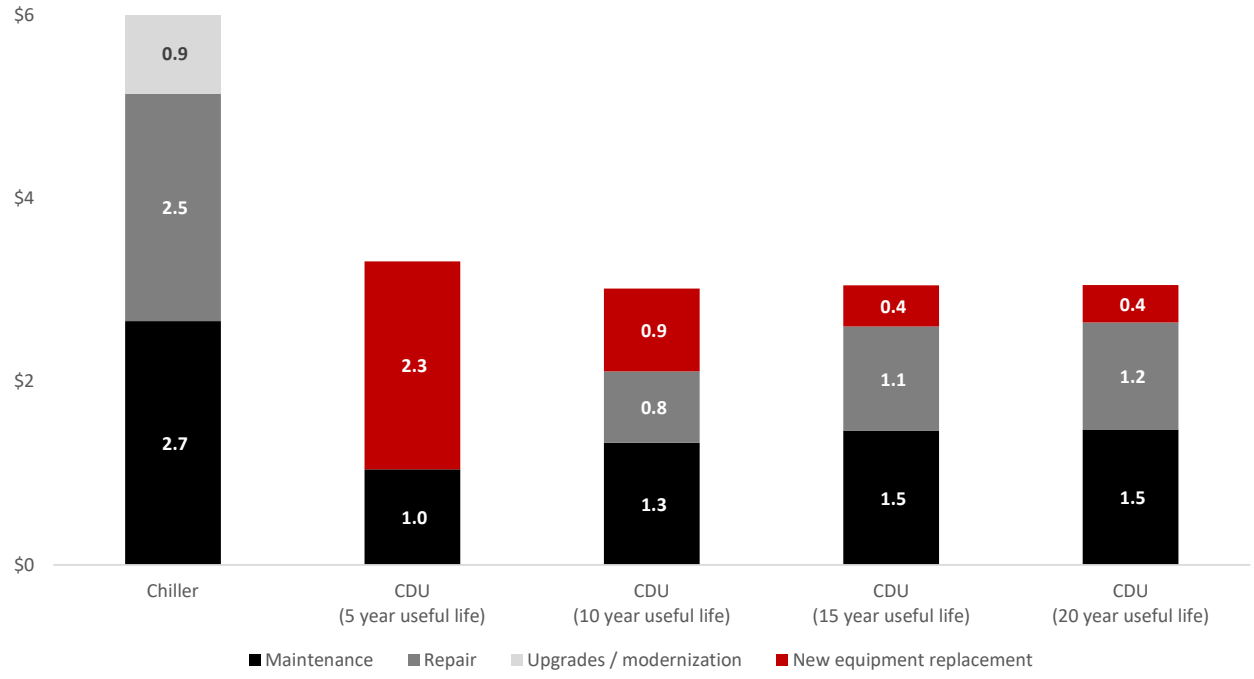
Note: We re-iterate our caveat up front, that the service tail of a CDU is largely unknown, and that this analysis is primarily to provide a framework for investors to assess how attractive it is compared to other components like chillers. We encourage readers of this note to download our model here and play around with their assumptions (which may be different from what we are making) to understand implications on their own investment portfolios.

EXHIBIT 7: **Decomposition of revenue streams after initial capex over a 25 year period (for every $100 of capex)**



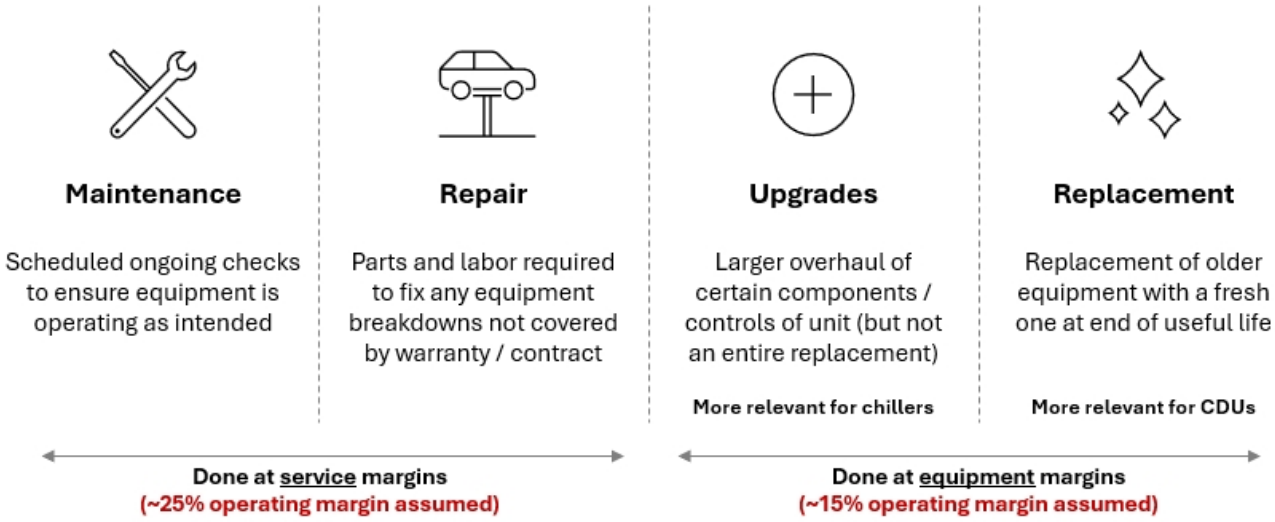
Source: Bernstein Analysis and Estimates, Expert Interviews

EXHIBIT 8: **Decomposition of operating profit margin streams after initial capex over a 25 year period (for every $100 of capex) at ~15% CDU new equipment margin**



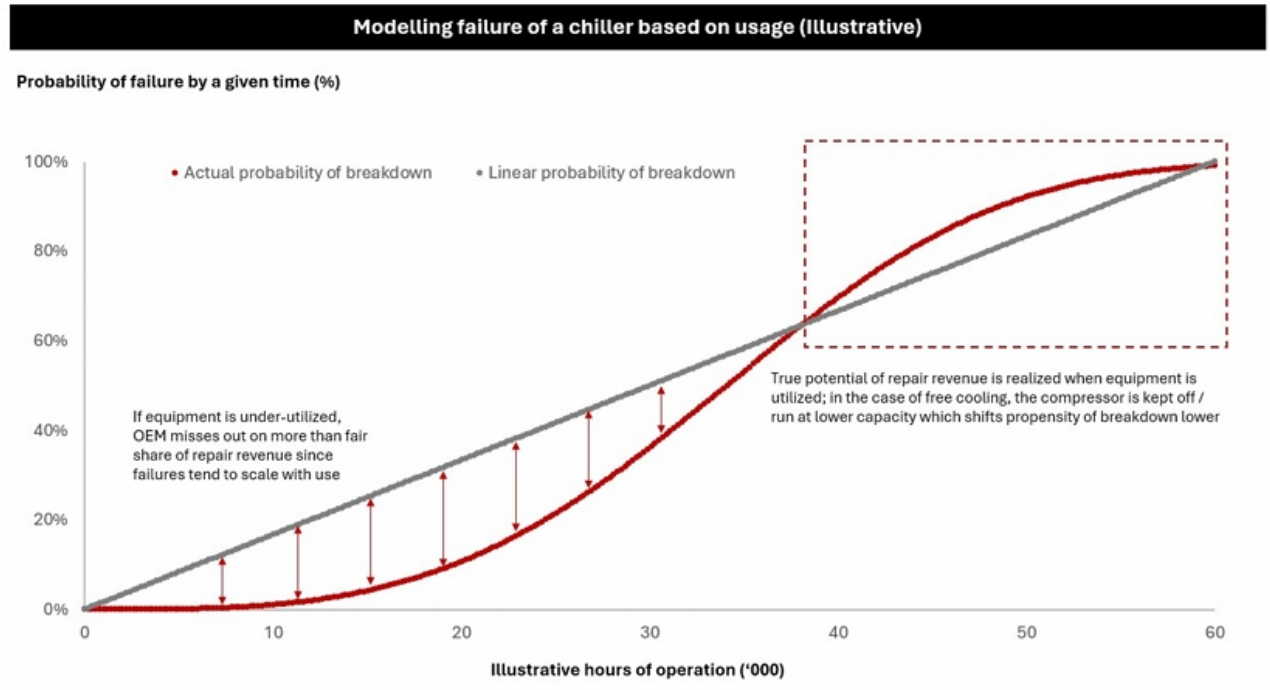
Source: Bernstein Analysis and Estimates, Expert Interviews

EXHIBIT 9: **Key revenue streams post-sale of new equipment (Chillers / CDUs)**



Source: Bernstein Analysis and Estimates, Expert Interviews

EXHIBIT 10: **Theoretical (modelled) vs. actual repair revenue distribution**



Source: Bernstein Analysis and Estimates

RECAP: PRIMER ON LIQUID COOLING

Liquid cooling encompasses multiple different types of technology, with varying levels of efficiency and at distinct stages of maturity. At their core, they share one common principle; liquid flows over a surface (directly or indirectly) and uses principles of convection to extract heat. We describe five modalities of liquid cooling below:

1. Single-phase DTC: The predominant format of liquid cooling today. DTC stands for Direct-To-Chip. It involves cold plates (which are aptly named slabs of metal that have reduced temperature due to refrigerant that circulates inside them) coming into contact with racks / chips to extract heat. Coolant Distribution Units (CDUs) pump low temperature coolant (usually a water-propylene glycol mix) through the plates and recollect the spent liquid once they have extracted heat from the server. The heat is then extracted from the coolant (making it cold again) and the process repeats. It is called single phase because the coolant stays in a single phase (liquid) and does not change phases from to gas via evaporation. This loop (i.e., circulating from the CDU through cold plates in the server) is called the TCS or technology cooling system. Once spent coolant reaches the CDU, it passes through a heat exchanger where it transfers heat to another cooling loop called the FWS or Facility Water System. The FWS connects to a chiller or dry cooler to reject this heat outside a data center. However, as rack power densities continue to increase, single phase DTC is seemingly reaching the theoretical limit of how much heat it can extract.

2. Two-phase DTC: The principles remain exactly the same as single phase DTC, but in this case the liquid coolant boils and evaporates when it comes in contact with the server after absorbing heat. Evaporation requires significant energy, so it enables the refrigerant to extract a lot of heat without having its own temperature rise too much. In most cases, the refrigerant is maintained as close to its boiling point as possible. Not yet mainstream, but a number of companies are experimenting at the lab scale and approaching commercial maturity (which is expected over the next couple of years). It is worth noting that capacities of CDUs that support two-phase liquid are limited; Accelsius for example has a relatively mature offering and their highest capacity CDU is well below 1MW (vs. 2MW+ for single phase cooling). Equipment (both CDUs and cold plates) need to be designed differently for two-phase; gas flowing through an ecosystem behaves much differently from liquid.

3. Immersion cooling: Once a competitor to DTC, now largely relegated to niche applications. Does not need cold plates; the entire server is submerged in dielectric (i.e., non-conducting) fluid which extracts heat. Has both single phase and two-phase versions. Fell off due to convenience; cold plates can rapidly be replaced and servers can still be maintained with relative ease, in contrast, immersion cooling requires a large tank to be moved, and a wet server to be extracted and dried before any work can be done on it. R&D is still taking place, but hyperscaler roadmaps clearly lean towards DTC.

4. Cold plate etched DTC: Micro-channels are etched into the surface of a cold plate to improve contact with the chip surface. Enables better heat transfer compared to traditional single phase or two-phase DTC but still very nascent tech.

5. Silicon-etched DTC: Forgoes cold plates entirely and etches cooling channels on the surface of the chip itself. Very nascent, unlikely to see commercialization before the end of the decade, although key players like Microsoft and TSMC are making investments here.

The reason we have laid out these technologies is that it has implications on the outlook of equipment that make up the liquid cooling ecosystem. CDUs and cold plates are the most important to discuss. CDUs (Coolant Distribution Units) are essentially responsible for controlling the distribution, flow, and pressure of coolant across multiple rows and racks. Cold plates receive coolant from CDUs (via a manifold) and absorb heat through their surface before returning the spent coolant to the CDU. Both these components are seeing significant demand (and shortages today) and there has been a flurry of investment activity in the space with larger players making strategic investments and acquisitions (e.g., JCI investing in Accelsius, Eaton acquiring Boyd).

Multiple pieces of equipment tie together to make liquid cooling work. A quick summary of each of these pieces of equipment is provided below (along with a deep-dive on CDUs).

1. CDUs: The beating heart of the liquid cooling ecosystem. Responsible for the interplay of two thermal loops (TCS and FWS). The TCS (or technology cooling system) pumps low-temperature coolant from the CDU to the server where it extracts heat generated by chips and recirculates it back. In the CDU, a heat exchanger transfers this collected heat from the spent coolant to the FWS (Facility Water System), effectively lowering the coolant temperature again. The heated water in the FWS then connects to a chiller or dry cooler to reject heat outside the data center.

2. Cold Plates: Pieces of metal that sit in the server and extract heat from racks by contact. Cold plates are cooled by the coolant (pumped by the CDU) that flows through them. More complex cold plate designs and geometries enable better heat transfer but also need higher pressure from the CDU. These are effectively consumable units; there is little to no service

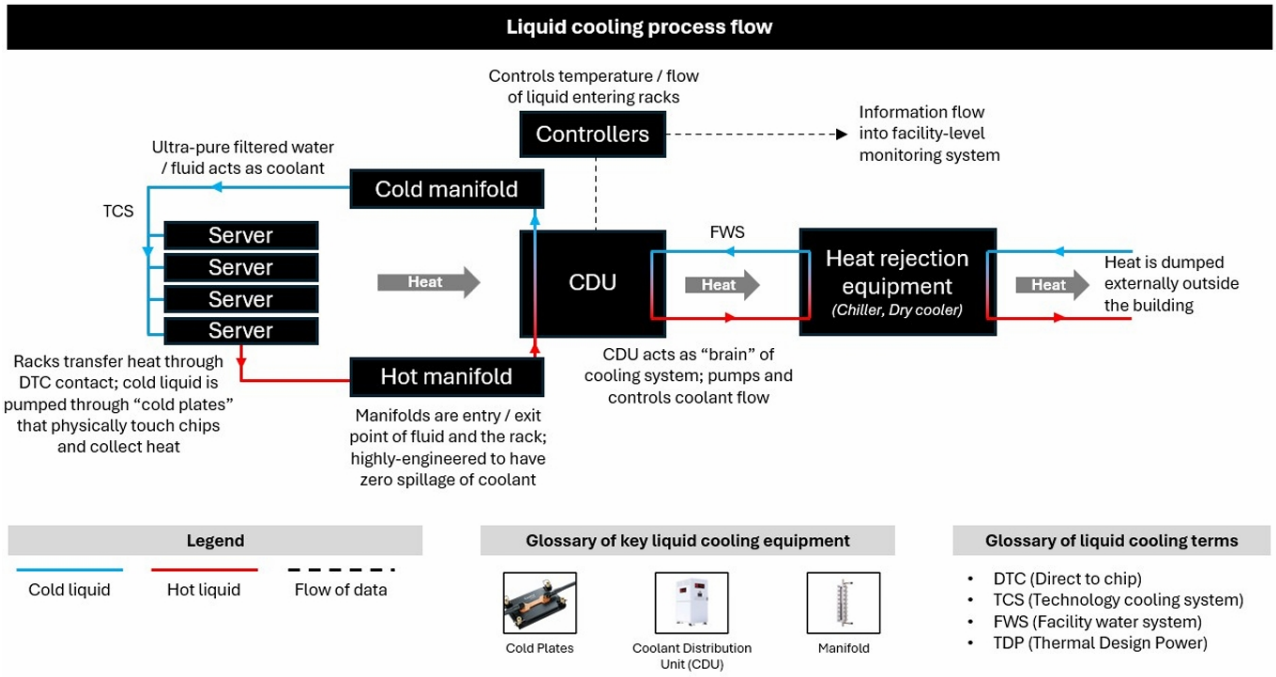
possible on them and the value of a cold plate is all in the design (fabrication is much simpler once you have a blueprint).

3. Manifolds: These are engineered pieces of equipment that control the flow of coolant from the CDU into the server / cold plate. They need to be highly engineered to ensure not even a drop of the coolant spills (because it creates electrical and fire hazards if it falls on an operating chip). The "no spill disconnect" capability of a manifold, where a cold plate or CDU can be disconnected without any spillage of coolant is a critical piece of the engineering. While an important piece of the liquid cooling ecosystem, it is not at the same level as CDUs or cold plates.

4. Coolant / refrigerant: Usually a mix of water and propylene glycol at the TCS side for single phase DTC cooling, this is responsible for capturing and rejecting heat. PG25 (a mix of 25% propylene glycol and 75% water) is the standard. While not as thermally conductive as water, it inhibits microbe growth, and has less corrosion risk, so engineers prefer using it. Some higher performance coolants also exist, but this is largely the standard. In the case of two phase DTC or immersion cooling, very different refrigerants will be needed. For example, in the case of two-phase DTC, the liquid needs to boil at relatively low temperatures. Similarly in the case of immersion cooling, the liquid needs to be non-conducting and generally exclude water to prevent corrosion risks.

5. Immersion tanks: Only needed in immersion cooling, not required for DTC. Large tanks that servers can be immersed into. Great heat transfer capabilities (especially with forced convection) but extremely tedious to maintain and service.

EXHIBIT 11: **Overview of Liquid Cooling and Key Components**



Source: Bernstein Analysis, Company Reports

RESEARCH INDEX

Primer Library

Liquid Cooling Primer: Coolant Distribution Units (CDUs)

Liquid Cooling Primer: Cold Plates

Data Center Chillers (1/3): Primer and free cooling economics

Data Center Chillers (2/3): How real is Chiller Gate risk?

Data Center Chillers (3/3): How much can "free cooling" impact chiller service revenues?

Data Center Cooling and Power: What's the $M per MW for different types of equipment

Orbital Data Centers: Content ($M/MW) Implications for Cooling Equipment Players

Other Relevant Research

Liquid Cooling: What does Google's Brazos mean for the broader CDU ecosystem?

Liquid Cooling in Data Centers: What comes after single phase DTC? With CoolIT's 15kW cold plate, does anything even need to?

Data Center Cooling: Chiller killer? Quick thoughts on Accelsius' two-phase cooling at >54 degree celsius inlet temperatures.

AI Data Centers: Procurement dynamics across power and cooling components (webinar recap)

US Industrials: 30 exhibits on the state of cooling and electrical equip. procurement in North American Data Centers

US Multis: Mapping the Data Center Service Footprint for Chiller OEMs (CARR / JCI / TT)

Initiations

US Multis Initiation: Thrills and Chills

US Multi Industrials: Can we (inter)connect? Initiating coverage with Outperform on Amphenol and TE Connectivity

The authors would like to thank Sakansh Mittal for his help in preparing this report.

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References to "Bernstein" or the “Firm” in these disclosures relate to the following entities: Bernstein Institutional Services LLC (April 1, 2024 onwards), Sanford C. Bernstein & Co., LLC (pre April 1, 2024), Bernstein Autonomous LLP, BSG France S.A. (April 1, 2024 onwards), Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, Sanford C. Bernstein (Canada) Limited, Sanford C. Bernstein (India) Private Limited (SEBI registration no. INH000006378), Sanford C. Bernstein (Singapore) Private Limited, Sanford C. Bernstein Japan KK（サンフォード・C・バーンスタイン株式会社）and analysts employed by Société Générale Africa Technologies & Services to produce Bernstein research under a Global Services Agreement in place between Bernstein and Société Générale.

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