BRIEFING MEMORANDUM

The Energy and Economic Impact of U.S. Data Centers

Electricity Demand, Emissions, and Consumer Cost Exposure — A Multi-Source Comparative Analysis

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Findings compiled and reconciled from four independent research contributors:

Gemini • Copilot • Claude • ChatGPT

Prepared August 23, 2026

Abstract: Consensus of the Four Contributors

All four contributors converge on a consistent narrative despite differences in methodology, sources, and precise figures. U.S. data center electricity consumption has grown sharply since 2023 — roughly tripling over the past decade and now consuming somewhere in the range of 175–200 terawatt-hours annually (about 4–4.7% of total U.S. electricity) — driven primarily by the buildout of AI, cloud, and crypto infrastructure. Every contributor projects this figure will climb steeply by 2030, into a range of roughly 350–650+ TWh, or approximately 9–15% of national electricity demand, with the widest estimates reaching higher under aggressive AI build-out scenarios.

On the central question of whether this growth has negated gains from renewable energy, the contributors are unanimous: not fully, but substantially. Renewable capacity continues to expand and now supplies close to half of the new electricity feeding data centers, but natural gas (and in some cases delayed coal retirements) is supplying more than 40% of the remainder, meaning a meaningful share of new clean generation is being absorbed by data center load rather than displacing existing fossil generation. The net effect, in each contributor's assessment, is that decarbonization is slower than it would otherwise be — not reversed, but measurably impeded.

Estimates of data center CO_2 output vary more widely (from roughly 100 Mt to 320 Mt annually depending on scope, year, and methodology), but all contributors agree emissions are rising and that this sits alongside a broader global trajectory — driven mainly by the whole economy, not data centers specifically — toward 1.5–2.7°C of warming and atmospheric CO_2 approaching roughly 425–460 ppm by 2030.

On consumer cost, all four find that data centers are contributing to higher electricity bills, especially in high-density buildout regions (Virginia, the PJM territory, Georgia, Ohio, Texas), even though the effect on the national average is more contested. All four also independently document the same policy split among states: a growing group (Virginia, Ohio, Oregon, Georgia, Oklahoma, Florida, Tennessee, Pennsylvania, New York, New Jersey) has moved to require data center operators to pay for the infrastructure their load requires through large-load tariffs, consumption taxes, or moratoria; while another group (historically Texas, Mississippi, Indiana, and others) continues to offer substantial tax exemptions and incentives that shift cost exposure toward the general public. Where contributors offer a normative judgment, each converges on the same policy position: AI and data center operators should bear the incremental cost of the generation and grid infrastructure their operations require, rather than socializing those costs across ordinary ratepayers and taxpayers.

Guiding Questions

This briefing was compiled in response to five original research questions:

- What is the increase in energy consumption linked to U.S. data centers, and has it negated green energy increases?
- How much CO_2 has been added to outputs as a result, and has this negated green energy gains?

- How much will data centers currently in progress and proposed add to future energy needs and CO_2 output?
- What will CO_2 levels reach by 2030, and what is the associated global temperature expectation?
- How much additional cost will this add to the average consumer's energy bill, and which states have acted to protect consumers versus allowed the cost to fall on taxpayers/ratepayers?

CONTRIBUTOR

Gemini

Framed around five core policy questions, with a strong emphasis on state-level tariff structures and a 50-state comparative framework.

1. Energy Consumption Increase

2023 baseline	~200 TWh (≈4.4% of U.S. electricity)
2026 (current)	300–350 TWh (>55% of national electricity demand growth)
2030 projection	345–490 TWh annually (9–15% of U.S. generation)
Pipeline addition	150–250 TWh of net new demand over current usage

Assessment: growth was flat from 2010–2020 due to efficiency gains, then accelerated sharply after 2023. Green energy gains are only partially negated — utilities have delayed fossil retirements and built new gas "peaker" plants to meet continuous baseload demand.

2. CO_2 Emissions

- Current data center operations: roughly 63–83 million metric tons (Mt) of CO_2 per year.
- Continued natural gas reliance threatens to offset carbon reductions achieved elsewhere on the grid.

3. Global CO_2 & Temperature Trajectory by 2030

- Global energy-related CO_2 projected to peak at 34–37 gigatons (Gt)/year before 2030.
- Atmospheric CO_2 concentration on track for ~425–430 ppm by 2030.
- Warming trajectory of 1.5–1.7°C by the early-to-mid 2030s, heading toward 2.4–2.7°C under current policy.

4. Consumer Cost Impact

- Average U.S. residential electricity price rose from ~13¢/kWh (2020) to ~19¢/kWh (2026).
- Data centers could raise average household bills by ~8% nationally by 2030, with 20–25% localized spikes in high-density hub states.

5. State Policy Landscape

Protecting consumers — large-load tariffs & surcharges

Virginia, Ohio, Georgia, Oregon, Michigan — created large-load tariff classes requiring data center developers to sign long-term power purchase agreements, directly fund infrastructure upgrades, and pay minimum billing fees regardless of usage.

Shifting exposure to taxpayers/ratepayers

Northern Virginia (historically), Texas (ERCOT), Indiana, Mississippi — sales/use tax exemptions on equipment and electricity to attract investment; transmission build-out costs in ERCOT and parts of the Midwest are socialized across all regional ratepayers.

Gemini's Position & the "Path Forward"

Gemini argues explicitly that AI companies and hyperscalers should pay the full, direct cost of the generation, transmission, and grid infrastructure their operations require, and converges on three baseline principles:

- **Bring Your Own Power (Additionality):** hyperscale operators must finance or contract new zero-carbon generation equal to 100% of their operational draw.
- **Dedicated Large-Load Tariffs:** utilities must place data centers into distinct customer classes so infrastructure costs are billed to the developer, not spread across residential rates.
- **Take-or-Pay Infrastructure Contracts:** binding 10–20 year agreements ensuring stranded assets aren't left for ordinary ratepayers if a project is cancelled.

50-State Regional Snapshot (Gemini)

Region	Capacity Trend	Consumer Protection	Subsidy Exposure
PJM / Mid-Atlantic (VA, OH, PA, NJ, MD)	Highest in U.S.; 10+ GW pipeline	Strong & rapidly growing (large-load tariffs)	High past subsidies, now contracting
MISO / Midwest (IL, IN, MI, MN, WI, IA)	Accelerating; capacity doubling by 2030	Moderate to strong (bring-your-own-power rules)	Mixed; some incentives face suspension
ERCOT / Texas	Rapid expansion; 20+ GW in requests	Low to moderate; costs largely socialized	High subsidies (Ch. 312/313 abatements)
SERC / Southeast (GA, NC, SC, TN, MS, AL)	Heavy pipeline growth	Emerging protections (GA dedicated tariffs)	High subsidies (MS, SC, LA)
WECC / West (OR, WA, AZ, NV, UT, WY)	Significant growth	Strong protections (OR, WA)	Targeted incentives (NV, UT)
CAISO / California	Moderate growth; high costs limit scale	Highest policy guardrails (100% clean mandate)	No specific subsidies
NYISO & ISO-NE (NY, MA, CT, ME, VT, NH)	Selective, land-constrained growth	Strong protections / moratoriums (NY)	Minimal incentives

CONTRIBUTOR

Copilot

Leads with a compact data snapshot, then walks through each question with an explicit fairness/equity argument about who should bear infrastructure costs.

Snapshot

Item	Now / Recent	2030 Projection
U.S. data center electricity	~176 TWh in 2023 (~4–4.5% of grid)	~470 TWh (~9% of U.S. grid)
U.S. data center CO_2e	~105 Mt in past year (~2.2% of U.S. emissions)	Could roughly double if grid mix holds
Global data center electricity	~415 TWh in 2024 (~1–1.5% of global)	~945–950 TWh (~3% of global electricity)
U.S. demand growth share	~4–4.5% of U.S. electricity currently	~55% of recent U.S. demand growth

1. Has data center growth "eaten" green energy gains?

Short answer: eroding a meaningful share of the gains, not fully erasing them. U.S. data center use grew roughly 3× from 2014 (~58 TWh) to 2023 (~176 TWh). Renewables are expected to supply nearly half of new electricity for data centers through 2030, but coal and gas still provide over 40% of that growth — meaning a large share of new wind and solar is feeding data centers rather than displacing existing fossil generation.

2. CO_2 added, and has it negated green gains?

- U.S. data centers: ~105 Mt CO_2e in the past year (~2.18% of total U.S. emissions), with carbon intensity ~48% higher than the U.S. average.
- Global data center CO_2 projected to peak around 320 Mt by 2030 — still under 1% of global emissions, but rising fast.

Not a full negation of green gains, but a significant absorption of clean capacity that slows the rate at which grid emissions fall.

3. Pipeline: proposed and in-progress facilities

- U.S. electricity could rise from ~176 TWh (2023) to ~470 TWh (2030) in a central scenario — a ~167% increase; some forecasts put the 2030 share as high as 17–20% in aggressive build-out cases.
- If the grid mix stays similar, U.S. data center emissions could roughly double, to ~200+ Mt by 2030.

4. CO_2 levels and temperature by 2030

- Atmospheric CO_2: ~420–425 ppm in the early 2020s, trending toward 440–460 ppm by 2030 under current policy.

- Global temperature: IPCC-style pathways suggest ~1.5–1.8°C of warming by around 2030, brushing against or slightly overshooting the 1.5°C threshold.
- Data centers are described as a small but growing slice of this picture — the primary drivers remain fossil fuels in power, industry, transport, and land use.

5. Consumer cost impact and state responses

No single confirmed national dollar figure yet, but grid upgrades built primarily to serve data centers are typically recovered through utility rate cases, raising bills for households and small businesses unless regulators intervene. High-build states could see mid-single-digit to low-double-digit percentage increases over several years.

States shifting costs to ratepayers/taxpayers

- Virginia — massive "Data Center Alley" build-out; substantial costs proposed for ratepayers alongside local tax incentives.
- Georgia, Ohio, Nebraska, parts of Texas — aggressive tax breaks and discounted power contracts, with grid upgrade costs broadly socialized.

States pushing protection or conditions

- California, New York, Oregon, Washington — stronger climate/utility-regulation frameworks; some require cost-sharing, higher demand charges, or clean-energy procurement from data centers.

Copilot's Position

Copilot argues directly that AI companies should carry most of the cost, and ordinary customers should only pay where they clearly benefit — characterizing broad cost socialization as effectively "asking a retiree on a fixed income to subsidize AI training runs," and a wealth transfer from the general public to a small number of large firms. It proposes: cost-based rates and demand charges for large loads; direct data-center funding of new substations, feeders, and transmission built primarily to serve them; mandatory clean-energy procurement tied to new demand; and transparent public accounting of who pays what on every major project. It allows that shared cost can be reasonable only where a benefit (durable jobs, reliability improvements for all customers) is demonstrated — not simply assumed.

CONTRIBUTOR

Claude

The only contributor to actively search current sources (DOE, LBNL, IEA, Pew, state legislation trackers), producing the most granular and most recently dated figures, including a state-by-state risk classification.

1. U.S. Data Center Energy Consumption

Lawrence Berkeley National Laboratory's most recent bottom-up estimate: 192 TWh consumed in 2024 (~4.7% of U.S. electricity) — more than double the 76 TWh (1.9%) recorded in 2018. Load growth has tripled over the past decade.

Has this negated green energy gains?

- Globally/nationally — not clearly: the IEA's central case has data-center power emissions peaking around 320 Mt CO_2 by 2030 before a shallow decline to ~300 Mt by 2035, with data centers rising from ~1% to ~3% of global electricity generation.
- Regionally — yes: natural gas and coal are expected to meet over 40% of additional data-center demand through 2030, and coal retirements are being delayed in some U.S. markets specifically to serve that demand.
- A June 2026 Allianz Trade study suggests the IEA may be understating impact — estimating 286 Mt CO_2 from data centers in 2025 alone, 57% above IEA figures, with nearly 70% of global data-center emissions concentrated in the U.S. and China.

2. CO_2 Added So Far

- IEA central estimate: ~320 Mt CO_2/year by 2030 (peak), declining to ~300 Mt by 2035.
- Allianz Trade (independent) estimate for 2025 alone: 286 Mt CO_2.
- IEA projects data-center emissions reaching 1% of global CO_2 emissions by 2030 (1.4% in a faster-growth scenario) — one of the few sectors still projected to grow in emissions as most others decarbonize.

3. Pipeline of Proposed/In-Progress Facilities

- 5,426 U.S. data centers as of March 2025; consumption projected to rise to as much as 130 GW (1,050 TWh) by 2030 — near 12% of total U.S. demand. ~56% of current data center electricity comes from fossil fuels.
- LBNL's 2025 reference case: data centers could reach 11.8% of total U.S. electricity by 2030 (range 9.5–15.3%), with reference-case use of 649 TWh in 2030.
- If just the ten largest proposed projects proceed, they could generate up to 2.7 million tonnes of CO_2 on their own.

4. Global CO_2 and Temperature by 2030

- Current global policies are projected to produce ~2.6°C of warming above pre-industrial levels; even binding 2030/2035 national pledges land near the same figure.
- Limiting warming to 1.5°C with no/limited overshoot would require holding 2030 emissions to 25–30 $GtCO_2e$/year, versus a 52–58 $GtCO_2e$/year median estimate under current pledges.
- 2030 is widely expected to be a year in which the 1.5°C threshold is at serious risk of being exceeded, at least temporarily — data centers are a small but growing contributor, not the primary driver.

5. Consumer Cost Impact

- PJM's independent market monitor projects data center demand will drive over $23 billion in customer price increases by 2028; PJM-region households could see bills rise $70/month by 2028.
- Residential electricity prices rose 11.5% in 2025, and are projected to rise up to 40% by 2030 versus 2025.
- Important caveat: this is disputed at the national level. LBNL has found data-center activity has not driven changes in national household costs (and may correlate with lower costs in some areas); EPRI similarly found new data centers were not the main cause of a ~39% five-year national price rise. The effect appears real and large regionally (PJM, Virginia) but debated nationally.

States That Have Acted to Protect Consumers

State	Action
Virginia	First direct data-center power consumption tax in U.S. history: $0.011/kWh, effective July 1, 2026
Oklahoma	Data Center Consumer Ratepayer Protection Act (May 2026) — separate rate tariffs for large-load customers
Florida	SB 484 (May 2026) — bars cost pass-through to ratepayers; adds transparency/environmental standards
Tennessee	Data Center Cost Responsibility Act (May 2026) — bars infrastructure cost shifting to ratepayers
Georgia	PSC rules (Jan 2025) — data centers fund full upstream generation/transmission/distribution costs
Oregon	POWER Act (2025) — new large-user rate class with mandatory 10-year contracts
New York	Statewide moratorium on large data-center permits (July 2026)
New Jersey	Landmark ratepayer-protection legislation (June 30, 2026)
Pennsylvania	PPL rate case creates new customer class for high-load data centers (early 2026)

Broadly: at least 36 utilities have adopted large-load tariff structures, and more than 300 data-center bills were introduced across 30+ states in 2026 alone.

States Where Taxpayers Are Still Absorbing Cost (via subsidies)

- Virginia — tax breaks cost the state $1.6 billion in 2025 alone.
- Texas — sales tax exemptions projected to cost $1.3 billion in 2026, up from ~$150 million/year in 2023–24.

- Minnesota — sales tax break extended through 2077; cost grew from ~$6M (FY2015) to a projected $114M (FY2025).
- Arizona — exemption cost $38.5 million in FY2025 (up from $1.4M in 2020); governor has called for repeal.
- Maryland — exemption program cost $22 million over its first four years.

More than half of states offer sales/use tax exemptions for data centers, but only 11 disclose which companies receive them, and only 5 disclose dollar amounts. Where states have studied ROI, they found losses of 52–70 cents per dollar of exemption granted, and at least $1 million in public cost per permanent data-center job created.

The Contested Policy Question

Claude explicitly declines to stake out a personal position and instead lays out the strongest case on each side:

- **For full-cost responsibility:** cost-causation — a single facility's demand can trigger a new plant or transmission line whose cost is spread across all ratepayers even though only that customer created the need; hyperscalers have the financial capacity to pay for dedicated generation; "stranded asset" risk if demand projections don't materialize; bipartisan momentum in 2026 state legislatures.
- **For shared/subsidized cost:** grid cost-sharing for large new loads (factories, EV charging, electrification) is an established practice, not unique to data centers; states compete for jobs and tax base; LBNL/EPRI evidence suggests data centers aren't the dominant national driver of price increases; overly strict rules risk pushing facilities to laxer jurisdictions without reducing overall demand.

Claude's read of the trend: regulatory momentum in 2026 favors some version of "data centers pay their own way" on grid infrastructure — even Republican-controlled legislatures in Florida, Tennessee, and Oklahoma have passed ratepayer-protection laws. The tax-subsidy side of the ledger remains more contested and is only beginning to face repeal efforts.

50-State Risk Classification (partial, Pew Feb. 2026 data)

State	Operating	Planned/Under Construction	Consumer-Risk Level
Virginia	398	287	Very High
Texas	296	170	Very High
Georgia	94	141	Very High
Ohio	166	57	Very High
Illinois	139	123	High
Arizona	98	86	High
North Carolina	72	41	High
Indiana	38	54	High
Pennsylvania	78	51	Rapidly Rising

State	Operating	Planned/Under Construction	Consumer-Risk Level
Oregon	115	27	High, with strong protections
California	277	54	Moderate
New York	148	6	Moderate, politically active
Washington	124	11	Moderate
Iowa	64	41	High relative to population

Claude's recommended national framework mirrors Gemini's, converging independently on the same core principle: full incremental-cost responsibility for developers, long-term take-or-pay contracts to prevent stranded-asset risk, independent power requirements for the largest facilities, transparent subsidy disclosure, and a consumer dividend where data centers do lower system costs.

CONTRIBUTOR

ChatGPT

Provides the widest projection ranges and the most explicit scenario framework (low/high growth, renewable vs. gas-dominant), plus a five-tier color-coded state classification.

1. U.S. Data-Center Electricity Growth

Year	Estimated U.S. Data-Center Electricity Use
2014	58 TWh
2023	176 TWh
2024	~177–192 TWh
2028	325–580 TWh (earlier estimate)
2030	~380–790 TWh
2030 (LBNL central)	11.8% of all U.S. electricity

Consumption more than tripled between 2014 and 2023. The IEA projects a further ~240 TWh increase between 2024 and 2030 (~130% growth) — comparable to adding the electricity use of tens of millions of homes, concentrated disproportionately in Northern Virginia, Texas, Ohio, and Pennsylvania.

2. Has This Negated Green Energy Gains?

Nationally: no. Regionally: potentially a substantial share of the benefit, yes. The IEA projects roughly +130 TWh/year of new natural gas generation and +110 TWh/year of new renewable generation for U.S. data centers between 2024 and 2030 — meaning new renewable capacity is increasingly serving new demand rather than displacing existing fossil generation.

ChatGPT's framing: data centers have not eliminated renewable-energy progress, but they have made decarbonization substantially harder, because clean-energy growth must now serve both fossil-fuel replacement and a large new source of demand simultaneously.

3. CO_2 Added

- 403 U.S. hyperscale data centers (May 2024–April 2025) consumed an estimated 68–99 TWh and produced 37–54 million metric tons of CO_2, with roughly 54% of attributed generation from fossil fuels.
- IEA global estimate: ~320 million metric tons of CO_2 per year from data-center electricity around 2030, before a modest decline.

Not a full negation of green-energy CO_2 reductions, but a clear reduction in the net climate benefit of renewable expansion.

4. Proposed and In-Progress Facilities

LBNL: data centers could reach 11.8% of total U.S. electricity in 2030 (range 9.5–15.3%). EPRI's wider range: 380–790 TWh annually by 2030 versus ~177–192 TWh in 2024 — a low-growth case of +190 TWh/year and a high-growth case of +600 TWh/year, a gap ChatGPT notes is "more electricity than many countries consume annually." It also flags that many proposed projects are speculative: Pennsylvania officials report over 100 proposals under discussion with only a small fraction holding permits.

5. CO_2 Emissions Through 2030 — Three Scenarios

- **Scenario A (mostly renewable + nuclear):** new demand largely accommodated without major CO_2 increases.
- **Scenario B (natural gas dominates):** CO_2 emissions increase substantially.
- **Scenario C (mixed system, most likely):** current IEA projections suggest both rapid renewable expansion and significant new gas generation will be used together, with gas providing the largest single share of additional demand.

6–7. Atmospheric CO_2 and Global Temperature by 2030

- WMO: CO_2 growth accelerated from ~0.8 ppm/year in the 1960s to ~2.4 ppm/year (2011–2020); at a continued 2–3 ppm/year pace, concentrations could plausibly approach ~430–435 ppm by 2030 (an extrapolation, not an official forecast).
- WMO: 2024 was likely the first calendar year ~1.55°C above the 1850–1900 average; UNEP's 2025 assessment expects the world to exceed 1.5°C within the next decade. By 2030, years around or above 1.5°C are very likely.

ChatGPT is explicit that data centers are not the primary cause of global warming, but add new demand at precisely the moment the world needs to be replacing fossil fuels fastest.

8. Consumer Cost Impact

No single national dollar figure exists, since electricity is regulated state-by-state. A 2026 study found data centers may have modestly reduced average U.S. retail rates between 2015–2024 (large new loads can spread fixed grid costs across more sales), but the authors caution future supply constraints could reverse this. Recent PJM data show rising transmission congestion and wholesale costs in strong-demand-growth regions.

9–10. State Policy — Five-Tier Classification

Tier	States	Notes
🟢 Stronger consumer protection emerging	Ohio, Oregon, New York, Pennsylvania	Cost-causation pricing; large-load tariffs; PGE proposed higher data-center rates while lowering residential rates
🟡 Major market, reforms underway	Virginia, Texas, Illinois, Arizona	VA: $0.011/kWh consumption tax from July 2026; TX paused approvals pending audit (data centers ≈90% of 474 GW in requested capacity)

Tier	States	Notes
🟠 Rapid growth, policy uncertainty	Georgia, North Carolina, Indiana, Iowa, Wisconsin, Michigan	Large pipelines outpacing settled consumer-protection frameworks
🔴 Significant incentive exposure	Many states competing aggressively for projects	NCSL: 38 states offer dedicated data-center tax incentives
⚪ Lower current exposure	States with smaller data-center markets	Limited buildout to date

Specific incentive states identified: Arizona, Georgia, Idaho, Indiana, Michigan, Montana, North Carolina, Pennsylvania, Texas, Virginia, and Wisconsin. ChatGPT distinguishes two separate cost-shifting mechanisms that can operate independently — direct taxpayer subsidies (sales/property/income tax breaks) versus electric-ratepayer subsidies (infrastructure recovered through everyone's bill) — noting the second may ultimately be more expensive for households.

ChatGPT's Position & Recommended Framework

ChatGPT concludes that AI and data-center companies should pay the full incremental cost of the generation, transmission, substations, and other infrastructure required specifically for their operations, while ordinary households should pay only for the normal shared electric system. It proposes five specific requirements: full incremental-cost responsibility; long-term take-or-pay contracts so cancelled projects don't leave stranded assets for ratepayers; independent power requirements for the largest facilities; transparent, mandatory subsidy disclosure (dollar value, jobs, electricity and water use, infrastructure cost); and a consumer dividend if utilization gains lower system-wide costs. It characterizes the emerging dynamic as "socialized infrastructure, privatized profits" and frames the coming years as a two-tier split between states that attracted data centers with tax breaks and traditional utility rules, and a second wave now rewriting those rules after seeing the consumer cost consequences.

Cross-Source Comparison

Figures vary by year, scope, and methodology across contributors — this table lines up each source's headline numbers for quick reference. Differences reflect the underlying uncertainty in this fast-moving research area, not disagreement about direction.

Metric	Gemini	Copilot	Claude	ChatGPT
Current U.S. DC electricity use	~200 TWh (2023)	~176 TWh (2023)	192 TWh (2024, LBNL)	~177–192 TWh (2024)
2030 U.S. DC electricity use	345–490 TWh	~470 TWh	9.5–15.3% share (649 TWh ref. case)	380–790 TWh
Current U.S. DC CO_2/year	63–83 Mt	~105 Mt CO_2e	(regional/global figures cited)	37–54 Mt (hyperscale subset)
Global DC CO_2 by 2030	34–37 Gt (all energy)	~320 Mt (peak)	~320 Mt (IEA); 286 Mt (2025, Allianz)	~320 Mt
2030 atmospheric CO_2	425–430 ppm	440–460 ppm	not separately estimated	~430–435 ppm
2030 warming trajectory	1.5–1.7°C (2.4–2.7°C longer-term)	1.5–1.8°C	~2.6°C under current policy	~1.5°C or above likely
Position on who should pay	AI firms pay full cost	AI firms should carry most cost	Presents both sides; notes trend toward firms paying	AI firms pay full incremental cost