Cities at the Center of the AI-Energy Transition: Building Inclusive Urban Energy Innovation Ecosystems

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Abstract

The United States is entering a new infrastructure era defined by artificial intelligence, electrification, and climate resilience. Cities are now the primary operating environment for this transformation—not utilities, not federal laboratories, and not isolated technology sectors. The central question is no longer simply how we generate clean energy. It is who owns the infrastructure, who shapes the innovation systems, and which cities capture the economic value.

This white paper argues that the AI-energy transition creates both an urgent governance challenge and a historic economic opportunity for American cities. Drawing on bibliometric analysis of 24,740 energy-related journal articles across three Southern metropolitan regions, federal funding data spanning 2010–2022, and 28 in-depth interviews with energy researchers, we document persistent, measurable exclusion of Historically Black Colleges and Universities (HBCUs) from the energy innovation ecosystem—and propose concrete structural interventions capable of converting that exclusion into inclusion before the architecture of the emerging AI-energy economy becomes permanently consolidated.

The central argument is twofold. First, HBCU exclusion from energy R&D is not a capacity problem—it is a structural problem produced by specific institutional mechanisms, and it is therefore addressable through deliberate structural reform. Second, that reform is now economically urgent: HBCUs are underutilized metropolitan assets, not peripheral institutions, and cities that fail to integrate them into regional innovation ecosystems are forfeiting workforce capacity, infrastructure resilience, and federal capital access at precisely the moment those assets are most competitively valuable.

≈1% HBCU share of federal energy R&D funding	**10%** of Black undergrads enrolled at HBCUs	**100–500 MW** per hyperscale data center facility	**$369B+** IRA clean energy investment (2022–2032 est.)

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Figure 1 (see below): Inclusive Urban Energy Innovation Ecosystem — A systems-level diagram illustrating interconnected relationships among HBCUs & Universities, Cities & Governments, Utilities & Grid Operators, Federal Labs & Programs, Industry & Manufacturing, Infrastructure Finance & IRA, Workforce Development, and

AI & Data Centers. Arrows indicate flows of capital, research, workforce, infrastructure, commercialization, ownership, and policy coordination. The figure reinforces that the AI-energy transition is an integrated metropolitan systems challenge—not an isolated research or utility sector issue



1. The Structural Geography of Energy Innovation

1.1 A System Built Without HBCUs

The modern U.S. energy innovation system was forged during and after World War II. Federal investments in nuclear science, aerospace, advanced materials, and computing established enduring ecosystems centered around federal laboratories and elite research universities. Institutions such as MIT, Stanford, Georgia Tech, and the University of California system became long-term beneficiaries of sustained federal contracting and deep industry integration.

HBCUs were deliberately excluded from that formative period. The Morrill Acts of 1862 and 1890, while establishing land-grant institutions for Black Americans, created a bifurcated system with systematically unequal resource allocations. The post-World War II era further entrenched these disparities: federal science agencies channeled resources through institutional networks from which HBCUs were largely absent—whether through segregation policy, lack of indirect cost infrastructure, or the absence of pre-existing federal contracting relationships.

The contemporary data confirm this inheritance. Across DOE, DoD, and NSF from 2010 to 2022, HBCUs accounted for approximately 1% of total federal energy-related higher education R&D expenditures—despite HBCUs enrolling 10% of Black undergraduates and producing a disproportionate share of the nation's Black science and engineering talent.

Agency	Total R&D	HBCU Total	HBCU Share
DOE	≈$20.8B	≈$180M	0.9%
DoD	≈$50.7B	≈$530M	1.0%
NSF	≈$62.0B	≈$620M	1.0%
TOTAL	≈$133.5B	≈$1.33B	≈1.0%

Table 1. Federal Energy-Related Higher Education R&D Expenditures, 2010–2022 (NSF HERD Survey). Approximate Values.

1.2 The Compounding Gap in Industry Partnerships

Industry-sponsored research disparities are even more pronounced. HBCU industry R&D shares declined from 0.21% to 0.11% of total national industry-sponsored university R&D between 2010 and 2022—even as overall corporate R&D at universities grew by more than 50%. On average, HBCUs captured approximately one-eighth of their federal R&D share from industry partners.

This gap reflects limited technology transfer infrastructure, smaller applied research portfolios, and the near-absence of formal corporate partnership agreements at most HBCU campuses. It also reflects a self-reinforcing cycle:

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without industry visibility, HBCUs cannot build the IP portfolios and tech transfer track records that attract corporate partners; without corporate partners, they cannot build visibility.

1.3 Regional Innovation Profiles

Our bibliometric analysis of 24,740 energy journal articles across North Carolina, Georgia, and Florida reveals substantial regional variation—and confirms that exclusion patterns are not uniform.

Metro Region	Leading HBCUs	Fed R&D Share	Industry R&D Share
Miami, FL	Florida Memorial Univ.	2.0–2.5%	<0.5%
Atlanta, GA	Clark Atlanta, Morehouse, Spelman	~1%	<0.5%
Research Triangle, NC	NC Central University	~0.9%	0.2%
Greensboro, NC	NC A&T, Winston-Salem State	1.2%	0.9%

Table 2. Regional HBCU Energy R&D Profiles, 2010–2022

2. AI Infrastructure, Cities, and the New Urban Energy Economy

2.1 AI Infrastructure Is Now a City Governance Issue

Artificial intelligence infrastructure is no longer a tech sector issue. It is an energy, water, housing, and city governance issue. Hyperscale data centers now require 100 to 500 megawatts per facility—the equivalent electricity demand of a mid-sized American city—operating 24 hours a day with no tolerance for intermittency. Projected U.S. data center electricity demand will grow more than 50% between 2024 and 2030, and data centers are expected to consume more than 8% of total U.S. electricity by 2030.

This growth is reshaping metropolitan regions across four interconnected systems simultaneously. On energy, grid interconnection queues are overwhelmed and new transmission infrastructure is urgently needed. On water, hyperscale cooling systems consume millions of gallons per day, competing directly with housing and agricultural systems. On housing, data center corridor development drives land speculation and displacement in peri-urban communities. And on governance, incentive packages are routinely offered to

data center operators without enforceable community benefit terms—meaning cities absorb infrastructure burdens without contracted returns.

Cities that lack the analytical capacity, institutional partners, and governance frameworks to manage this convergence will find AI infrastructure expanding within their boundaries in ways that reshape their tax base, housing markets, and grid reliability without generating proportional community benefit.

2.2 The Strategic Contradiction Cities Must Solve

The AI-energy transition confronts city leaders with a structural contradiction that existing governance frameworks were not designed to resolve. AI infrastructure demands firm, continuous 24/7 power—baseload electricity that cannot tolerate the intermittency of wind and solar. Climate goals, by contrast, require integrating large shares of intermittent renewable sources into grids designed for flexible consumption. Cities must solve both simultaneously, and the systems through which they must do so—energy, water, housing, transit, and digital infrastructure—were not designed for this convergence.

The result is that energy systems can no longer be planned separately from land use, housing, resilience, workforce, and digital infrastructure. Metropolitan regions that continue to treat these as separate policy domains will find themselves unable to capture the economic value of AI infrastructure investment while also meeting climate commitments and maintaining housing affordability. Integrated urban energy governance—connecting energy planning to housing, water, workforce, and digital infrastructure—is no longer an aspirational policy goal. It is an operational necessity.

> ***"Cities must solve the AI-energy contradiction simultaneously—and the systems they must use were not designed for this convergence."***

2.3 The Infrastructure Risk Cities Cannot Ignore

For city leaders and planners, the fiscal and governance risks of the AI-energy transition are concrete and immediate. Six dimensions of exposure deserve direct attention.

Grid reliability exposure is perhaps the most immediate: cities bear the fiscal costs of grid failures through emergency response, critical services disruption, and lost economic productivity—yet have limited control over grid planning decisions made by utilities and federal regulators. Land speculation and displacement represent a parallel risk: data center corridor development drives peri-urban land costs upward, accelerating residential displacement and straining city affordable housing budgets precisely in communities that can least absorb those pressures.

Water competition is an underappreciated fiscal risk: hyperscale cooling demands compete directly with municipal water systems in climate-stressed metros. Infrastructure without inclusion compounds these pressures: communities absorb infrastructure burdens—noise, emissions, grid stress,

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increased traffic—without proportional economic participation or ownership. Workforce leakage drains the tax base: regions without clean energy workforce pipelines export trained talent and import contractors, neither of which builds local fiscal capacity. And energy affordability pressure is rising: electricity rates driven up by new large loads disproportionately strain low-income residents and city housing subsidy budgets.

Without intentional governance, cities repeat a familiar pattern: infrastructure expansion without equitable participation in ownership or long-term economic value. The institutional mechanisms required to break that pattern—community benefit agreements, HBCU workforce pipelines, Direct Pay financing structures—are available. What is required is the governance commitment to use them.

2.4 IRA Capital Flows and Urban Infrastructure

The Inflation Reduction Act is not only the largest climate legislation in U.S. history—it is a fundamental restructuring of who can own clean energy infrastructure. By creating direct ownership pathways for cities, nonprofits, public universities, and HBCUs, the IRA transforms the institutional architecture of clean energy finance in ways that have no precedent in U.S. energy policy.

Before the IRA, clean energy finance depended on federal competitive grants, utility-controlled incentives, philanthropic capital, and state programs—all of which systematically routed resources away from institutions without established sponsored research infrastructure or tax liability. After the IRA, new pathways exist: Direct Pay for cities, nonprofits, and HBCUs; transferable tax credits accessible by emerging partnerships; Energy Community bonuses targeting historically burdened regions; Advanced Manufacturing credits for domestic supply chains; and DOE loan programs and Green Banks providing catalytic public capital alongside enforceable Community Benefit Agreements.

Three IRA mechanisms are particularly consequential for HBCU-adjacent communities and city leaders:

Direct Pay (Elective Pay) — Cities, Nonprofits, and HBCUs Can Now Own Infrastructure

For the first time in U.S. energy policy, Direct Pay provisions allow nonprofits, public universities, municipalities, and tribal governments to monetize clean energy tax credits directly—without requiring a tax liability. This is transformative for HBCUs, city governments, and community development organizations that have historically been excluded from infrastructure ownership. Campus microgrids, community solar installations, EV charging networks, and district energy systems can now be financed through mechanisms that generate direct cash returns to HBCU-affiliated and city-affiliated projects.

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Transferable Tax Credits — New Private Capital Pathways

IRA transferability provisions allow clean energy tax credits to be sold to third parties, enabling smaller institutions and emerging HBCU–industry partnerships to monetize incentives without requiring large tax appetites. This creates new pathways for co-investment between HBCUs and private capital partners, lowering barriers to large-scale clean energy project development that have historically excluded HBCU-affiliated institutions.

Energy Community Bonuses and Justice40 Alignment

Many of the metropolitan regions anchored by HBCUs—Gulf Coast, Atlanta metro, North Carolina's Piedmont, and South Florida—qualify as Energy Communities under the IRA, unlocking bonus tax credits for clean energy deployment. These designations align directly with Justice40 commitments that 40% of federal clean energy benefits flow to disadvantaged communities. HBCU-centered regional strategies are not only equitable—they are economically advantaged under current federal investment frameworks.

2.5 National Competitiveness and Strategic Infrastructure

The United States is entering a period in which energy infrastructure, artificial intelligence, advanced manufacturing, and digital systems are becoming increasingly inseparable. Global competition in semiconductors, AI computing, grid modernization, battery manufacturing, and resilient infrastructure is accelerating simultaneously. In this environment, the exclusion of major institutional and regional talent pools from energy innovation ecosystems is no longer solely an equity concern—it is a national competitiveness challenge.

The convergence of AI infrastructure and energy systems presents a particularly urgent strategic issue. Hyperscale computing facilities require enormous volumes of reliable electricity, thermal management systems, transmission capacity, and advanced power electronics. The United States simultaneously faces growing shortages of engineers, grid modernization specialists, energy systems analysts, cybersecurity professionals, and advanced manufacturing talent. HBCUs represent one of the nation's most underutilized assets in addressing these constraints: NC A&T is the largest U.S. producer of Black engineers, FAMU has sustained industry partnerships in applied engineering, and Morehouse, Clark Atlanta, and Spelman maintain active research programs in materials science, AI, and energy modeling.

HBCUs collectively enroll approximately 10% of Black undergraduates in the United States but receive only 1% of federal energy R&D. That ratio represents not just an equity gap—it represents a structural mismatch between the nation's stated workforce development goals and its actual investment patterns. The Inflation Reduction Act, CHIPS and Science Act, and related industrial policy

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initiatives now create an opportunity to correct that mismatch before the concentration patterns of the mid-20th century become permanently embedded in the emerging AI-energy economy.

Cities capable of integrating HBCUs into regional energy innovation ecosystems gain concrete competitive advantages: stronger workforce pipelines, greater infrastructure resilience, expanded access to federal investment, and a broader coalition for industrial recruitment. Metropolitan regions that fail to broaden participation risk underutilizing local talent while exacerbating infrastructure inequality and social instability in communities that are already energy-burdened.

> ***"Underutilizing HBCU capacity is not an equity abstraction. It is a national competitiveness error with measurable economic and strategic costs."***

3. The Framework: Inclusive Urban Energy Innovation Ecosystems

The future energy economy will not be built by any single actor, but by interconnected instituions. Innovation ecosystems succeed when infrastructure, finance, research, workforce, and deployment operate together—and when the institutions anchoring those systems include, rather than exclude, the HBCUs, community organizations, utilities, and municipal governments that shape metropolitan life. Drawing on empirical findings, regional innovation theory, and the Triple Helix model of university–industry–government relations, we propose a six-element framework for building inclusive, urban-centered energy innovation ecosystems.

Element 1: HBCU–PWI–Industry Research Triads

Collaborative teams co-led by an HBCU, a Predominantly White Institution (PWI), and an industry partner—with shared IP rights, transparent governance, and explicit capacity-building resources for the HBCU—represent the most direct mechanism for addressing both the inclusion and tokenism problems simultaneously. These triads must be structurally distinct from conventional subcontracting arrangements. When industry partners set shared governance expectations, distribute IP rights equitably, and define substantive leadership roles for HBCU researchers as conditions of engagement, they counteract the tokenistic collaboration patterns currently documented in co-authorship networks.

Element 2: Federal Laboratory Integration

Federal laboratories represent one of the most underutilized mechanisms for inclusive innovation. Partnership Intermediary Agreements (PIAs) authorize national labs to collaborate with universities, nonprofits, and small businesses on technology transfer and commercialization—precisely the kind of structured engagement that could provide HBCUs with access to federal datasets, advanced instrumentation, and mission-relevant research problems. DOE and

DoD should require that UARCs (University Affiliated Research Centers) and PIA agreements include meaningful HBCU sub-agreements with substantive research roles and dedicated funding streams. Howard University's leadership of UARC-RITA demonstrates this potential: the center brings explicit capabilities in AI and tactical autonomy and represents the first DoD UARC led by an HBCU consortium.

Element 3: Regional Clean Energy Corridors

The future of inclusive energy innovation may emerge through regional clean energy corridors that integrate research institutions, digital infrastructure, advanced energy systems, manufacturing, workforce development, and community benefit agreements. Three corridors merit particular attention:

- Miami Climate Resilience Corridor: Integrating FMU, FIU, University of Miami, and Florida Atlantic in coastal resilience, smart energy systems, and AI-driven infrastructure planning—with local small Climate businesses such as Solis Power and Exowatt and Beacon Council as deployment anchors
- Atlanta Climate Innovation District: Leveraging the Georgia Institute of Technology and the Atlanta University Center consortium—Clark Atlanta, Morehouse, Spelman—with growing NSF and DOE funding in materials science and data-driven energy modeling.
- North Carolina Clean Energy Manufacturing Corridor: Building on NC A&T's established partnerships with Boeing, Lockheed Martin, and Siemens Energy in grid modernization, advanced materials, and EV systems

Element 4: Equity Metrics in Federal Funding and Contracting

Embed HBCU participation requirements—with clear deliverables, governance roles, and accountability mechanisms—as evaluation criteria in DOE, DoD, and NSF energy R&D solicitations. The Justice40 Initiative, which commits that 40% of the benefits of federal clean energy investments flow to disadvantaged communities, creates precisely this political and policy opening. Federal agencies should require reporting on HBCU subcontract amounts, publication co-authorship, and patent co-inventorship as standard program metrics.

Element 5: HBCU Research Infrastructure Investment

Direct investment in laboratory modernization, sponsored research administration, tech transfer office capacity, and faculty research time is a prerequisite for HBCU participation in large-scale federal programs. Infrastructure grants modeled on the NSF EPSCoR program—but scaled to the magnitude of the gap they are intended to address—represent the most direct mechanism for building the capacity that federal contracting mechanisms currently require. AI infrastructure companies can also strengthen these investments by partnering with HBCU boards of trustees, academic leaders, and community stakeholders to

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coordinate infrastructure planning, align resources, and ensure that federal investments deliver lasting benefits to HBCU campuses and surrounding communities.

Element 6: Inclusive Clean Energy Finance and IRA Deployment

The IRA introduces unprecedented opportunities for inclusive participation in energy infrastructure deployment. Elements 1 through 5 address the research and institutional dimensions of HBCU exclusion. Element 6 addresses the deployment and finance dimension—the mechanisms through which research is converted into owned infrastructure, economic activity, and community wealth. HBCUs, municipalities, and regional coalitions should leverage IRA tools to establish clean energy deployment partnerships tied to workforce development, technology commercialization, and community ownership.

Strategic deployment opportunities directly relevant to HBCU campuses and surrounding communities include campus microgrids financed through Direct Pay, community solar serving HBCU-adjacent low-income households, resilient district energy systems co-developed with utilities, EV charging infrastructure tied to HBCU workforce training, thermal storage and long-duration storage R&D commercialized through regional corridors, grid modernization partnerships leveraging HBCU advanced materials and engineering programs, energy-efficient affordable housing integrating HBCU architectural and engineering programs, and clean energy advanced manufacturing anchored in HBCU regional corridors.

IRA Advanced Manufacturing Credits — A Strategic Opportunity for HBCU Corridors

Advanced Manufacturing Production Credits (Section 45X) and Investment Tax Credits for domestic manufacturing facilities represent a particularly powerful opportunity for HBCU-anchored regional corridors. NC A&T's partnerships with Boeing, Lockheed Martin, and Siemens Energy position the North Carolina corridor to compete for battery, transformer, and grid systems manufacturing. The Atlanta University Center's materials science capabilities and FMU's Climate Resiliency Center focus offer similar entry points. Federal agencies and industry partners should prioritize HBCU participation in IRA-supported manufacturing through procurement incentives, technical assistance, and co-development frameworks.

3.1 Implementation Pathway

Achieving inclusive urban-centered energy innovation requires more than isolated pilot programs or symbolic partnerships. It requires coordinated institutional sequencing capable of integrating research, infrastructure deployment, commercialization, workforce systems, and capital formation over time. The following phased pathway provides a practical framework for cities,

universities, federal agencies, and industry partners seeking to operationalize the six-element model.

Phase I — Research and Institutional Integration

Initial efforts should focus on integrating HBCUs into existing regional research ecosystems through structured HBCU–PWI–industry collaborations, federal laboratory partnerships, and shared infrastructure agreements. Key priorities include research co-authorship and joint proposal development, laboratory modernization and instrumentation support, sponsored research administration capacity building, formalized federal laboratory engagement through PIAs and UARCs, and development of regional innovation governance structures.

Phase II — IRA Deployment and Infrastructure Partnerships

Once institutional collaboration pathways are established, regional coalitions should transition toward deployment-focused infrastructure initiatives enabled by IRA finance mechanisms: campus microgrids, community solar, EV charging infrastructure, district energy systems, utility partnership agreements, and workforce-aligned infrastructure deployment. This phase converts research participation into infrastructure ownership and long-term economic participation.

Phase III — Commercialization and Manufacturing Ecosystems

Long-term competitiveness requires integration into domestic clean energy manufacturing and commercialization systems. Regional innovation corridors should pursue advanced manufacturing partnerships, technology commercialization pipelines, supply chain integration, startup incubation, energy technology demonstration platforms, and industry co-developmentagreements. The IRA's advanced manufacturing incentives create a historic opportunity for HBCU-centered regional corridors to participate directly in emerging clean energy industrial supply chains.

Phase IV — Regional Economic Transformation

The ultimate objective is the creation of resilient regional innovation economies capable of sustaining long-term wealth creation, workforce development, and infrastructure ownership. Mature ecosystems should integrate municipal planning, utility modernization, resilient housing systems, climate adaptation, advanced workforce pipelines, clean transportation systems, digital infrastructure planning, and community wealth-building strategies. Inclusive urban energy innovation ecosystems are ultimately regional economic development systems—not merely research collaborations.

4. Policy Recommendations for Cities

Most of the actions below are executable under existing federal authority and current IRA structures—they do not require new legislation. They require commitment, coordination, and governance intentionality from four categories of

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actors: cities, utilities, HBCUs and universities, and industry.

For City and Regional Leaders

- Designate energy innovation districts anchored by HBCUs, with explicit roles in regional clean energy corridor planning and federal funding access
- Require community benefit agreements with enforceable local hiring, energy affordability, and workforce training terms as conditions of data center and energy infrastructure permits
- Integrate energy, housing, water, and digital infrastructure planning through unified metropolitan strategy frameworks—these systems cannot be governed separately in the AI-energy transition era
- Use IRA Direct Pay provisions for municipal clean energy projects to demonstrate the ownership model and build city-HBCU co-development capacity
- Establish IRA technical assistance offices within economic development agencies to help HBCUs, CDFIs, and community organizations navigate Direct Pay and transferable tax credit mechanisms
- Create urban energy innovation intermediaries—public-private organizations with PIA-like authority to broker HBCU–federal lab–industry partnerships at the regional level

For Utilities and Grid Operators

- Prioritize HBCU-adjacent grid modernization partnerships and provide transparent interconnection pathways for campus and community solar projects
- Pilot district energy and thermal storage systems in partnership with HBCU campuses as demonstration and commercialization platforms
- Expand community solar programs specifically targeting energy-burdened households in HBCU-adjacent communities, using IRA incentives to reduce barriers
- Create dedicated interconnection pathways for small-scale distributed generation projects affiliated with HBCU campuses, community solar programs, and municipal energy initiatives

For HBCUs and Universities

- Build IRA Direct Pay deployment programs on campus—beginning with solar, storage, and EV charging—as anchors for broader regional clean energy corridors
- Launch HBCU–PWI–industry research triads with shared governance, co-IP agreements, and substantive HBCU leadership roles from the outset
- Develop technology transfer and commercialization capacity through partnerships with federal labs, regional innovation intermediaries, and

industry co-development programs
- Anchor workforce pre-apprenticeship pipelines connecting HBCU campuses to clean energy career pathways across the regional value chain

For Industry Partners

- Co-develop IRA-eligible projects with HBCU partners as substantive co-leads, not subcontractors—with shared IP, shared governance, and shared economic returns
- Establish co-IP agreements and shared governance frameworks that prevent the tokenistic collaboration patterns currently documented in energy research partnerships
- Fund workforce training at HBCU campuses through community benefit agreements tied to data center and clean energy infrastructure projects
- Prioritize local hiring requirements in community benefit agreements, with HBCU workforce pipeline programs as a contracted supply mechanism
- Leverage transferable tax credits to structure HBCU co-development partnerships—sharing credit value to enable institutions with limited tax appetite to participate meaningfully in project finance

IRA Mechanisms: A Reference for City and HBCU Leaders

The table below summarizes the IRA provisions most relevant to HBCU-centered urban energy strategies, providing a practical reference for practitioners and policymakers navigating implementation.

IRA Mechanism	Relevance to HBCUs & Cities	Strategic Application
Direct Pay (Elective Pay)	Allows nonprofits, public universities & municipalities to monetize tax credits without tax liability	Campus microgrids, community solar, district energy, EV charging
Transferable Tax Credits	Credits can be sold to third parties; lowers capital barrier for smaller institutions	HBCU–industry co-development; commercialization of campus clean energy projects
Energy Community Bonus	Bonus credits (up to 10%) for projects in qualifying communities; some HBCU regions qualify	Gulf Coast, Atlanta metro, NC Piedmont, South Florida corridors

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45X Manufacturing Credit	Production credit for domestic clean energy manufacturing components	NC A&T, AUC, FMU corridor manufacturing partnerships
48C Advanced Manufacturing ITC	Investment tax credit for qualifying advanced energy manufacturing facilities	Regional clean energy manufacturing hubs co-anchored by HBCUs

Table 3. Key IRA Mechanisms for HBCU-Centered Urban Energy Strategies

Why Cities Should Care

The energy transition is increasingly unfolding at the metropolitan scale. Cities are now the primary operating environments for AI infrastructure, electrified transportation, resilient power systems, advanced manufacturing, climate adaptation, and digital connectivity. Decisions regarding energy infrastructure deployment increasingly shape housing affordability, tax base growth, land use patterns, workforce competitiveness, and long-term economic resilience.

For city leaders, the exclusion of HBCUs from regional innovation ecosystems represents not only an equity concern but also a missed economic development opportunity. HBCUs function as anchor institutions in many metropolitan regions, supporting workforce development, entrepreneurship, cultural identity, and local economic activity. Integrating these institutions into energy innovation ecosystems can strengthen local supply chains, improve workforce retention, increase access to federal investment, and expand community participation in infrastructure ownership.

Conversely, infrastructure systems developed without inclusive governance mechanisms risk intensifying displacement, infrastructure inequality, and economic fragmentation. Data centers, transmission corridors, energy generation assets, and advanced manufacturing facilities are reshaping metropolitan geographies. Cities that fail to integrate equity into infrastructure planning may absorb rising infrastructure burdens without capturing proportional economic benefits.

The future competitiveness of metropolitan regions will depend not only on infrastructure deployment itself, but on who participates in designing, financing, operating, and benefiting from that infrastructure.

Conclusion

The exclusion of HBCUs from the U.S. energy innovation ecosystem is documented, durable, and structurally produced. Our findings establish that HBCUs receive approximately 1% of federal energy-related R&D funding and a fraction of that from industrial partners—not because of institutional incapacity but because the mechanisms through which energy research is funded and

organized systematically foreclose their participation. The AI-energy transition does not resolve that structural problem automatically. But it does raise the cost of inaction: the metropolitan regions that fail to integrate HBCUs into their energy innovation ecosystems are now forfeiting workforce assets, infrastructure resilience capacity, and federal capital access at a moment when those assets are uniquely valuable.

The Inflation Reduction Act fundamentally changes the landscape of that challenge. It creates, for the first time, a set of deployment and finance mechanisms—Direct Pay, transferable tax credits, energy community incentives, and advanced manufacturing credits—that are accessible to the nonprofits, public universities, and municipal governments that have historically been excluded from energy infrastructure ownership. The question is whether cities, federal agencies, utilities, and industry partners will act with sufficient intentionality to ensure those mechanisms reach HBCU communities—or whether the IRA's benefits will flow through the same concentrated institutional channels that have perpetuated exclusion for eight decades.

The next generation of energy infrastructure will not be built solely through technological innovation. It will be built through decisions regarding institutional access, infrastructure ownership, capital flows, workforce systems, and regional governance. The Inflation Reduction Act creates an unprecedented opening to broaden participation in these systems before the architecture of the emerging AI-energy economy becomes permanently consolidated.

The opportunity before cities is therefore larger than energy transition alone. It is the opportunity to redesign regional innovation ecosystems in ways that align technological advancement with inclusive economic development, infrastructure resilience, and long-term community participation in wealth creation. Whether that opportunity is realized will depend on the willingness of public institutions, federal agencies, industry leaders, and metropolitan regions to treat inclusion not as a peripheral social objective, but as a core component of national energy and economic strategy.

> ***"The question is not whether America will build a new energy economy. The question is which cities will shape it, who will own it, and whether communities will participate in the prosperity it creates.***

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Note: The bibliometric analysis of 24,740 energy-related journal articles

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across Atlanta, GA; Miami, FL; and the Charlotte–Raleigh–Durham, NC metropolitan regions, as well as qualitative findings from 28 semi-structured interviews with Black energy researchers across HBCUs, PWIs, and federal laboratories, are drawn from this peer-reviewed publication.

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Note: The statistics cited in this paper regarding data center electricity demand—including 100–500 MW per hyperscale facility, 50%+ projected demand growth 2024–2030, and the 8%+ share of U.S. electricity consumed by data centers by 2030—are drawn from Lawrence Berkeley National Laboratory analyses and related federal energy modeling.

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