2025 - The critical role of energy allocation in Swedens wealth creation

Q2 2025: How Sweden deploys its energy advantage will have the biggest effect on prosperity since the 1800's

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Executive summary

One kilowatt-hour. Three futures. Pour it into green steel and you create roughly €0.23 of value. Pour it into an EV battery and you create €5.84. Pour it into AI and you create €450 — almost 2,000× the steel number, and 77× the battery. This is not a marginal preference between good options; it is the largest per-kWh value gradient any modern economy has ever faced, and it is open for the taking right now.

For nations with clean, surplus electricity, the implication is stark and exhilarating: how a country routes its electrons over the next few years will shape its prosperity more than any policy lever since industrialisation. Sweden in particular sits on a once-in-a-century alignment — abundant fossil-free power, a cool climate, owner of world-class fiber, deep engineering talent, and a population small enough to move fast and skilled enough to punch far above its weight. The question is no longer whether to participate in the AI economy. It is whether to treat energy and AI as a single, integrated national strategy — and to do so before the window closes.

The energy conundrum

This paper examines energy as the fundamental constraint in artificial intelligence development, analyzing how the strategic allocation of this finite resource shapes economic outcomes across sectors. We demonstrate that directing one kilowatt of electrical power toward AI systems generates approximately 77 times more economic value than the same power allocated to electric vehicle battery production, and nearly 2,000 times the value of fossil-free steel manufacturing. This extraordinary differential emerges from AI's unique capacity to create compounding intellectual capital and drive productivity gains across entire economic systems.

As global energy constraints intensify amid climate change mitigation efforts, policymakers and industry leaders face critical decisions about energy prioritization. We argue that the exponential value-creation potential of AI must be balanced against essential but lower-return decarbonization activities in basic materials and transportation. This tension highlights the need for sophisticated energy allocation frameworks that consider both immediate economic returns and the preservation of energy access for fundamental human needs and industrial processes.

Our analysis concludes that energy efficiency improvements in AI systems represent the most economically valuable research direction, potentially unlocking new domains of computational capability while reducing competition for limited energy resources. This perspective reframes the AI development paradigm from one of computational limits to one fundamentally constrained by energy availability, with profound implications for economic policy, infrastructure investment, and technological research priorities.

When evaluating the economic value of 1 kilowatt-hour (kWh) of power across these three applications, we must consider several factors:

Fossil-Free Steel Production

The economic value of 1 kWh directed toward fossil-free steel production lies in:

- Carbon emission reduction (potentially €50-80/ton CO_2 in avoided carbon taxes/credits)
- Premium pricing for green steel (10-30% premium in current markets)
- Strategic value in decarbonizing a fundamental industrial material
- Long-term competitiveness in increasingly carbon-regulated markets

Electric Vehicle Batteries

For EV batteries, 1 kWh contributes value through:

- Higher value-added manufacturing (typically €150-250/kWh of battery capacity)
- Enabling multiplier effects across the transportation ecosystem
- Contribution to energy storage capabilities beyond transportation
- Accelerating transition from fossil fuel vehicles (€0.10-0.15/km in fuel savings)

Generative Artificial Intelligence

In AI applications, power allocation creates value via:

- Extraordinarily high value-added services (potentially €500-5,000+ per kWh used in training)
- Exponential productivity improvements across sectors
- Enabling novel innovations and services otherwise impossible
- Knowledge acceleration effects that compound over time

The highest economic value likely falls to AI, as it represents a transformative general-purpose technology with exceptional return on investment. However, this assumes sufficient complementary assets (skills, data, infrastructure) are in place to fully leverage the technology.

The strategic decision may ultimately depend on your specific industrial context, existing capabilities, and time horizon for value realization rather than a pure kWh comparison.

Comparative Economic Value Analysis: 1 kWh Across Strategic Sectors

Calculation of the approximate gross economic value generated from 1 kWh of electricity in each sector:

1. Fossil-Free Steel Production

- Energy requirement: ~4,500 kWh per ton of green steel
- Value of green steel: ~€900-1,000 per ton (with green premium)
- Economic value per kWh: €900 ÷ 4,500 kWh = **€0.20 per kWh**
- Additional carbon value: €50-80 carbon price per ton CO_2 avoided (~1.8 tons CO_2/ton steel)
- Carbon value per kWh: (€65 × 1.8) ÷ 4,500 kWh = **€0.026 per kWh**
- Total economic value: **€0.226 per kWh**

2. Electric Vehicle Batteries

- Energy for battery cell production: ~80 kWh per kWh of battery capacity
- Value of battery capacity: ~€150-250 per kWh capacity
- Economic value per kWh of input electricity: €200 ÷ 80 = **€2.50 per kWh**
- Additional value from EV usage (over vehicle lifetime): ~€0.10/km × 200,000 km lifetime ÷ 75 kWh battery = €267 per kWh capacity
- Battery usage value per kWh of input: €267 ÷ 80 = **€3.34 per kWh**
- Total economic value: **€5.84 per kWh**

3. Artificial Intelligence

- Energy for AI training: ~1,000 MWh for large model training
- Economic value created: ~€50-100 million for enterprise AI implementation
- Direct value per kWh: €75,000,000 ÷ 1,000,000 kWh = **€75 per kWh**
- Ongoing inference value (5× training value over system lifetime): **€375 per kWh**
- Total economic value: **€450 per kWh**

Comparative Analysis

Based on this approximate calculation:

- Fossil-Free Steel: **€0.23 per kWh**
- EV Batteries: **€5.84 per kWh**

- Artificial Intelligence: **€450 per kWh**

AI demonstrates the highest gross economic value by approximately 77× compared to EV batteries and nearly 2,000× compared to green steel production per unit of electricity input.

These calculations represent order-of-magnitude estimates based on current market conditions and best available data. Actual values would vary based on specific implementation contexts, technological developments, and market dynamics.

Energy Conversion Value Formulas

1. Fossil-Free Steel Production

Formula: $$V_{steel} = \frac{(P_{steel} \times V_{ton}) + (C_{price} \times CO_2_{avoided})}{E_{required}}$$

Where:

- V_{steel} = Economic value per kWh (€/kWh)
- P_{steel} = Green steel premium (typically 10-30% above standard steel)
- V_{ton} = Base value per ton of steel (€/ton)
- C_{price} = Carbon price (€/ton CO_2)
- $CO_2_{avoided}$ = Carbon emissions avoided per ton (typically 1.8 tons CO_2/ton steel)
- $E_{required}$ = Energy required per ton of steel (approximately 4,500 kWh/ton)

Example calculation: $$V_{steel} = \frac{(€900/ton) + (€65/tonCO_2 \times 1.8 tonCO_2/ton)}{4,500 kWh/ton} = €0.226/kWh$$

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2. Electric Vehicle Batteries

Formula: $$V_{battery} = \frac{V_{capacity} + (F_{savings} \times D_{lifetime} \div C_{battery})}{E_{production}}$$

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Where:

- $V_{battery}$ = Economic value per kWh input (€/kWh)
- $V_{capacity}$ = Market value per kWh of battery capacity (€/kWh capacity)
- $F_{savings}$ = Fuel cost savings (€/km)
- $D_{lifetime}$ = Vehicle lifetime distance (km)
- $C_{battery}$ = Battery capacity (kWh)
- $E_{production}$ = Energy required to produce 1 kWh of battery capacity (kWh input/kWh capacity)

Example calculation: $$V_{battery} = \frac{€200/kWh_{capacity} + (€0.10/km \times 200,000km \div 75kWh_{capacity})}{80 kWh_{input}/kWh_{capacity}} = €5.84/kWh_{input}$$

Example calculation:

$$V_{battery} = \frac{€200/kWh_{capacity} + (€0.10/km \times 200,000km \div 75kWh_{capacity})}{80kWh_{input}/kWh_{capacity}} = €5.84/kWh_{input}$$

3. Generative Artificial Intelligence

Formula: $$V_{AI} = \frac{(V_{direct} \times R_{models}) + (V_{inference} \times L_{deployment})}{E_{training}}$$

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$$V_{AI} = \frac{(V_{direct} \times R_{models}) + (V_{inference} \times L_{deployment})}{E_{training}}$$

Where:

- V_{AI} = Economic value per kWh (€/kWh)
- V_{direct} = Direct economic value created per AI model (€)
- R_{models} = Success rate of models (percentage of models deployed)
- $V_{inference}$ = Ongoing value from inference (€/year)
- $L_{deployment}$ = Average deployment lifetime (years)
- $E_{training}$ = Energy consumed in model training (kWh)

Example calculation: $$V_{AI} = \frac{(€75,000,000 \times 0.25) + (€15,000,000/year \times 5 years)}{1,000,000 kWh} = €450/kWh$$

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$$V_{AI} = \frac{(€75,000,000 \times 0.25) + (€15,000,000/year \times 5years)}{1,000,000kWh} = €450/kWh$$

Comparative Efficiency Ratio

The relative economic efficiency of energy allocation can be expressed as:

$$ER_{comparative} = \frac{V_{AI}}{V_{alternative}}$$

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For AI versus steel: $$ER_{AI:steel} = \frac{€450/kWh}{€0.226/kWh} \approx 1,991$$

For AI versus batteries: $$ER_{AI:battery} = \frac{€450/kWh}{€5.84/kWh} \approx 77$$

These formulas demonstrate the profound differences in economic value creation per unit of energy input across these three strategic sectors, highlighting the exceptional returns from energy allocated to AI development, while acknowledging that base industrial processes remain essential despite lower per-kWh returns.

Final words

For Sweden, the question is no longer whether it has the energy to compete — it is how that energy is deployed. Clean, abundant hydro and nuclear power is the country's most natural and most strategic resource, and the choices made over the next few years about where each kilowatt-hour flows will shape Swedish prosperity more decisively than any policy lever pulled in a generation. Allocating a sizeable chunk of that power toward the highest-value applications — rather than defaulting it to legacy industrial uses or exporting it as an undifferentiated commodity — is how a small nation converts a geological and infrastructural endowment into compounding national wealth. The analysis above makes the stakes concrete: the gap between €0.23 and €450 per kWh is not a rounding error, it is the difference between selling raw energy and selling intelligence built on top of it.

Sweden also holds a genuine comparative advantage in building out AI, and it is one that compounds. The fundamental inputs are already here: surplus fossil-free electricity, a cool climate that lowers data-center cooling loads, political and regulatory stability, deep engineering talent, a vibrant globally recognized start-up eco system, and a digital public infrastructure most countries are still trying to assemble. Sweden also sits on one of the world's largest dark-fiber footprints — a quietly decisive asset, since it is far easier to move bits through fiber than electrons through high-voltage lines, and AI workloads can be placed where the power is and served to where the demand is. Crucially, this can be done "AI style" — with a population of just under 11 million highly educated people, Sweden does not need to win on headcount, it needs to win on leverage per person, which is precisely what AI rewards. A small, skilled, well-capitalized country pointing its cleanest electrons at its highest-leverage technology is exactly the configuration that produces outsized national returns. The decade ahead will not be kind to nations that treat energy and AI as separate policy files; for Sweden, treating them as a single strategy is the path to a durable advantage.

Jonas Kjellstrand is a senior strategic adviser operating through UCC AB, based between Stockholm and Palo Alto. He advises at the intersection of European sovereign AI infrastructure, Nordic energy economics, government relations, and Silicon Valley technology partnerships. He holds an MBA from Stanford GSB (joint with Stockholm School of Economics) and business administration from MIT Sloan.