Addenda #47 – June 2024
Re: Ch. 8, 2050 Net-Zero Emissions; Impossible!
SDG 7 – Ensure access to affordable, reliable, sustainable and modern energy for all

US electricity load growth forecast jumps 81% led by data centers, industry: Grid Strategies

Data from FERC Form 714 shows grid planners expect nationwide power demand to grow 4.7% over the next five years, compared to a previous estimate of 2.6%.
UtilityDive; December 13, 2023

- *U.S. electric load is growing significantly faster than grid planners previously expected, led by new manufacturing and industry and the growth of data centers, according to a Tuesday report from Grid Strategies. Electrification, hydrogen production and severe weather are also contributing.*
- *Reports filed this year with the Federal Energy Regulatory Commission show grid planners expect nationwide electricity demand to grow 4.7 % over the next five years — while 2022 estimates called for just 2.6% growth. Peak demand is expected to grow 38 GW over the next five years.*
- *The electric grid "is not prepared for significant load growth," the report concludes.*

Artificial Intelligence, touted as being so beneficial for mankind, will also have extreme negative effects on society. In November 2017, a study from global management consulting firm McKinsey & Company estimated between 400 and 800 million jobs worldwide could be lost to automation due to AI by 2030, 16 to 54 million in the U.S. alone. [1]
A July 2023 update by McKinsey titled *Generative AI and the future of work in America,* predicted Generative AI and automation designed using AI, could take over tasks accounting for 29.5 percent of all hours worked in the U.S. economy by 2030. [2]

But a more real, near-term threat from Artificial Intelligence to global energy stability and Agenda 2030 net-zero emissions goals has been in the news in recent weeks.

➢ *Electric demand for data centers:*

Traditional *data centers* use a combination of computer servers, networking equipment, backup storage systems and cooling equipment, to provide computing, communications and data services to businesses and governments. Data centers vary in terms of size and power requirements, but larger data centers can consume as much electricity as a small town.
A typical 2,000 square foot housing unit (single family home or apartment) is wired for 24-kW electric consumption (100-amps) but uses about 8.5-kW of electricity on average.
A smaller 20,000 square foot data center can use up to 5-MW of power, the equivalent of 588 housing units. [1 MW = 1,000 kW = 1 million watts]
A larger 100,000 square foot data center can demand 20-MW of power, the equivalent of 2,353 housing units
A "mega-data center" consisting of millions of square feet can demand more than 100-MW of electricity to power its equipment, the equivalent of 11,764 housing units.

Amid explosive demand, America is running out of power

AI and the boom in clean-tech manufacturing are pushing America's power grid to the brink. Utilities can't keep up.

The Washington Post; March 7, 2024

Vast swaths of the United States are at risk of running short of power as electricity-hungry data centers and clean-technology factories proliferate around the country, leaving utilities and regulators grasping for credible plans to expand the nation's creaking power grid.

In Georgia, demand for industrial power is surging to record highs, with the projection of new electricity use for the next decade now 17 times what it was only recently. Arizona Public Service, the largest utility in that state, is also struggling to keep up, projecting it will be out of transmission capacity before the end of the decade absent major upgrades.
Northern Virginia needs the equivalent of several large nuclear power plants to serve all the new data centers planned and under construction. Texas, where electricity shortages are already routine on hot summer days, faces the same dilemma.
Consider this: California imports 29% of all the electricity it uses and power plants in Arizona and Utah provide 53% of all the electricity imported by California. Uh-Oh!!

AI could drive a natural gas boom as power companies face surging electricity demand

AI Commission; May 5, 2024

After a decade of flat power growth in the U.S., electricity demand is forecast to grow as much as 20% by 2030…. Power companies are moving to quickly secure energy as the rise of AI coincides with the expansion of domestic semiconductor and battery manufacturing as well as the electrification of the nation's vehicle fleet.
AI data centers alone are expected to add about 323 terawatt hours [TWh] *of electricity demand in the U.S. by 2030…. The forecast power demand from AI alone is seven times greater than New York City's current annual electricity consumption of 48 terawatt hours. Goldman Sachs projects that data centers will represent 8% of total U.S. electricity consumption by the end of the decade.*
Note: This added load from data centers, will consume one-half of all the electricity that was produced by all "true renewables" in 2023 (663 TWh). Think about *that* for a minute!

A New Surge in Power Use Is Threatening U.S. Climate Goals

A boom in data centers and factories is straining electric grids and propping up fossil fuels.
New York Times; March 14, 2024

Over the past year, electric utilities have nearly doubled their forecasts of how much additional power they'll need by 2028 as they confront an unexpected explosion in the number of data centers, an abrupt resurgence in manufacturing driven by new federal laws, and millions of electric vehicles being plugged in.
Many power companies were already struggling to keep the lights on, especially during extreme weather, and say the strain on grids will only increase. Peak demand in the summer is projected to grow by 38,000 megawatts nationwide in the next five years….
[Reference: Addenda #44, April 2024; NY Electric Grid Reliability-Resource Adequacy]

- *How Prepared is New York States Power Grid??*

In 2019, New York state Passed the *Climate Leadership and Community Protection Act* to *"confront the greatest threat facing life as we know it — a rapidly changing climate".*
The CLCPA set the aggressive goal of reducing emissions statewide by at least 85% below 1990 levels by 2050. The CLCPA also set the goal to achieve 70% zero-emission electricity by 2030 and 100% zero-emission electricity by 2040.
Cutting greenhouse gas emissions at this scale, will require the reduction and eventual elimination of virtually all fossil fuel energy consumption from personal vehicles, trucks, busses, and residential and commercial heating and cooking.
To achieve this goal, massive amounts of zero-emission renewable energy production sources, wind and solar will have to be constructed and connected to the state's electric grid.

New York utility companies commissioned a study on the states electrical grid in early 2020 in order to prepare for this transition to "electrification". The *New York Power Grid Study*, published in January 2021, looked at all pieces of the grid: generation, transmission, and estimated future electrical loads due to the electrification required by the CLCPA legislation. [3]
The utility companies, in cooperation with the NY Independent System Operator, used a modelling scenario evaluating the impacts of 70 percent of energy produced from renewable resources by 2030 (70x30) for both *Transmission Security* and *Resource Adequacy*.
(NYISO is responsible for ensuring a reliable power grid and competitive energy markets)

Section one of the report detailed assumptions on the amount of renewable electricity generation the grid would have to carry by 2030.
"Of the utility-scale wind and solar generation capacity assumed in 2030 in the CARIS analysis, approximately 2 GW consist of existing resources, with the remaining 28 GW assumed to be added over the next decade." [1 GE = 1,000 MW = 1 billion watts]
Note: Again, only "true renewables", wind and solar, are being considered in this plan.
This additional generation will come solely from on and off-shore wind farms, utility-scale solar farms and private use "distributed solar" installations.

Section Two of the report identified and developed local transmission and distribution projects that would have to be upgraded to increase to handle the additional renewable generation loads.
These projects were divided into two phases. Phase 1 were projects that needed to be addressed immediately to *satisfy Reliability, Safety, and Compliance purposes* as well as upgrade sections of the grid not currently able to handle the additional renewable energy generation. These projects were upgrades to the high voltage distribution facilities and transmission lines that carry electricity within New York state.

Phase 2 of the Grid Study identified additional requirements to increase capacity on local transmission and distribution systems, to allow for interconnection and delivery of new renewable generation sources within the utility's system.

➢ *Incomplete Assumptions and Updated Costs*

There were 113 projects identified as Phase 1 immediate requirements, totaling $6.8 billion, the cost of which would be "recovered" from the utility customers through higher delivery service rates and fees. [4]
There were 71 additional projects identified under Plan 2. These projects were still in the initial design stages in 2020 and were not included in the utility companies' capital plans, but the estimated cost at that time was just over $10 billion.
The total cost for Plan 1 and Plan 2 projects came to $17.3 billion in the 2020 estimate. [5]

Since the power grid study was completed, price increases of four to nine times have been reported in the past 3 years on utility distribution equipment and lead time from order to delivery has increased to as long as two years. Cost estimates calculated in 2020 are no longer valid for estimating the final costs of the projects listed in the grid study.
Just a four percent increase in equipment costs could add $30 million, or more, in additional costs to that 2020 estimate to utility customers over the next decade. [6]

Note: These distribution and transmission upgrades are to be made on the high-voltage (115 kV to 345 kV) transmission levels, to handle increased loads between power generation sources to electric substations across the state.
These projects do not include upgrades to the medium-voltage (35 kV and below) transmission levels, found at the "street level" in local villages, towns and cities.
"The Study acknowledges that it does not capture the full extent of renewable curtailments and congestion due to the fact that it does not examine constraints at the lower-voltage local transmission facilities."
Initial Report on the New York Power Grid Study, page 83

➢ *Incomplete Assumptions and Updated Load Requirements*

Artificial intelligence experienced significant growth between 2000 and 2019, but nothing like the surge in developments over the past four years. Generative AI, the ability to generate images, text, videos, and other media in response to inputted prompts, through programs like ChatGPT, was just emerging from the development stage in 2020. It has only been in the past two years that there has been an explosion in the construction of new data centers to support the growth in AI.

In 2020 when the Power Grid Study was being put together, total electric demand for new data center construction and leasing in the U.S. was 696 MW. In 2022, new construction and leasing had increased demand to 3,161 MW. In 2023, the demand reached 5,632 MW. The largest new developers will complete construction and become operational in U.S. markets over the next few years—with AI requirements driving further demand.

In 2022, Congress passed the CHIPS and Science Act, providing $280 billion in funding for new research and manufacturing of semiconductors in the US. More than a dozen projects are in the planning or construction phases, including the Micron Technology semiconductor plant project right here in Central New York.
To provide enough power to run this plant, National Grid will have to expand an existing substation and run eight new 345,000-volt lines to the site. When fully built, the complex of four chip fabs could use as much power as 2 million households.
There are an estimated 8.6 million households in NY state as of July 2023, so this plant could consume as much electricity as one-quarter of all the households in the state! [7]

➢ *The Bottom Line: 70% Zero-Emission Electricity by 2030… Impossible!*
100% Zero-Emission Electricity by 2040… Impossible!!

The very first article cited in this addendum was a report published in December 2023 by *Grid Strategies*, a transmission and power market consulting group. Their report focused on the following issues:

- *Over the past year, grid planners nearly doubled the 5-year load growth forecast.*
- *The main drivers are investment in new manufacturing, industrial, and data center facilities.*
- *The U.S. electric grid is not prepared for significant load growth.* [8]

The calculations in the NY Power Grid Study were based on electrical load studies done by the New York ISO Electric System Planning Working Group. The "High-load Forecast" in the 2019 CARIS 70x30 report was modeled on the addition of 900,000 light-duty electric vehicles (EV's) and transition to heat pumps for electrified space heating.
This projection showed electric demand increasing 5,000 GW by 2030. There was no factoring in for additional high-energy manufacturing or data center expansion. [9]

"The Utilities' general approach was to assess the operation of their LT&D systems at the levels of renewable generation projected for 2030. The Utilities based their 2030 renewable generation assumptions on NYISO's 2019 CARIS 70x30 scenario, which models approximately 30,000 MW [30 GW] *of utility-scale renewable generation resources across the eleven NYISO zones by 2030…"*
Initial Report on the New York Power Grid Study, page 15

The CARIS study also only projected resource needs out to 2030. The Power Grid Study stated that *"there is uncertainty as to what the resource generation mix and capacities will likely be in 2030 and 2040 and where the resources will be located. This uncertainty will have implications for the grid's investment needs."*

The Power Grid Study did project potential total installed renewable capacity, ranging from 53-66 GW by 2040, depending on future demand factors.

The New York Power Grid Study was based on the addition of just 28 GW of utility-scale wind and solar generation. The CARIS study also assumed imports of Canadian hydroelectricity of 1.3 GW dedicated for New York City, counted towards 70x30 goals. At the same time, this study assumed the retirement of four nuclear power plants in NY state by 2029, all remaining coal fired power plants by 2021, and all oil burning 'Peaker plants" in NY City by 2025, for a total loss of 5.7 GW of electric generation capacity. [10]

Even though New York state *had* a plan in place to deal with a large buildout of solar and wind power sources, and the increased loads required by electrification of all aspects of our lives, they were not prepared for the explosion of AI data centers and high-tech/clean-tech factories. These changes have rendered those plans obsolete.

"In summary, we conclude that the Zero Emissions Study's projected 2040 installed total renewable generation capacity and transmission needs likely are at the low end of the uncertainty range. If more renewable generation is necessary to achieve CLCPA goals or renewable and storage development differs in mix and locations, more bulk transmission may be required than identified in the Study. In addition, the Study's results for 2040 bulk transmission infrastructure needs should be viewed as only part of the overall power grid picture, because local transmission needs and CLCPA headroom associated with local transmission are addressed in the Utility Study as discussed earlier in this report."
Initial Report on the New York Power Grid Study, page 84

Note: The 2020 New York Power Grid Study planned for a total of 30 GW of renewable energy generation to be operational by 2030. The Micron chip plant alone will require a minimum of 640 GW for its Clay, NY facilities. [11]

"Micron has promised to buy all that electricity from renewable sources, a promise that reflects New York state's commitment to have an emission-free electric grid by 2040. But Micron could find it tough to keep that promise unless the floodgates open to new wind and solar farms."
How would Micron's electricity-hogging plant here live with NY's war on fossil fuels?; Syracuse.com, February 28, 2023
Impossible !!

- *Final Thoughts*

1. This continual "moving of the goalposts" on projected energy demand, is not getting NY state any closer to achieving the emissions goals of the CLCPA or de-carbonization of the electrical grid.
2. Continued energy demand, whether from new industry or technology demands, only ensures continual electric grid transmission upgrades as more and more new sources of power are added. Continued double digit rate hikes as noted in Addenda #45 – May 2024, will be proposed every couple of years making our energy bills an even more burden on middle-class ratepayers: Just as it was designed to do!

Addendum Reference Notes:

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10. 2019 CARIS 70x30 Scenario; New York ISO, March 16, 2020
    https://www.nyiso.com/documents/20142/11350020/04%202019CARIS1_70x30Scenario.pdf/202a845b-6026-6f43-c1dc-55ba3a016d48
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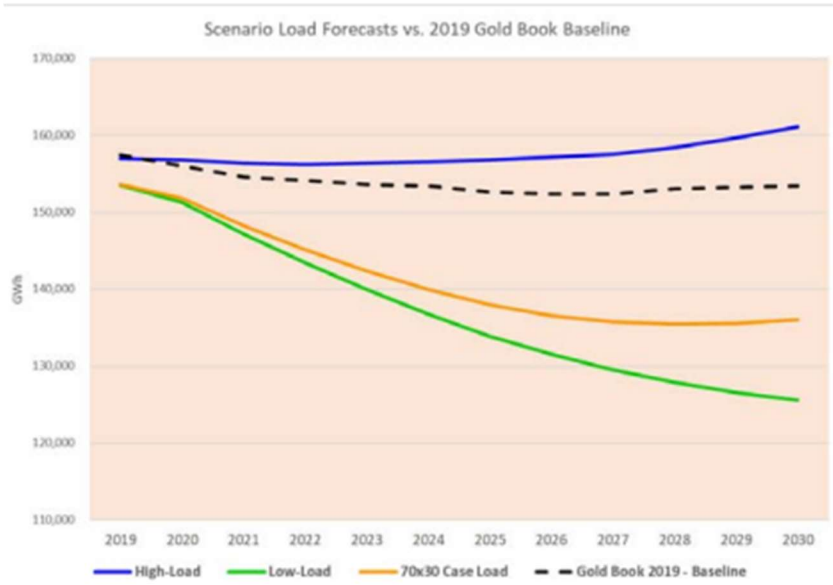
    https://www.syracuse.com/news/2023/02/how-would-microns-electricity-hogging-plant-here-live-with-nys-war-on-fossil-fuels.html

New York ISO 2019 CARIS 70x30



3 Scenario Load Forecast

High-load Forecast 162,500 GWh
Higher penetration of Electric Vehicles (EV) and Heat Pumps for electrified Space Heating plus 'baseline' forecasts for EE & PV
Note: No distinction made between Air Source Heat Pumps and Ground Source Heat Pumps

Low-load Forecast 125,833 GWh
Reflects Climate Leadership and Community Protection Act (CLCPA) targets with respect to behind-the-meter photovoltaic (PV) and Energy Efficiency (EE) plus 'baseline' forecasts for EV and no Heat Pumps

'70 x 30' Load Forecast 136,250 GWh
Incorporates scenario forecasts for EV, Space Heating, EE and PV

NYSERDA – New York Electricity Generation 2019

2019 Actual Net Generation	134,537 GWh	
Existing "true renewable" generation *	4,506 GWh	(utility-scale solar & wind)
Hydropower generation	30,724 GWh	
Other renewables generation	816 GWh	
Nuclear generation	44,788 GWh	
Total non-fossil fuel generation	80,834 GWh	60.0%
* True Renewables generation	1,139 GWh	3.35%
Natural Gas-Fired generation	49,451 GWh	
Petroleum-Fired generation	1,994 GWh	
Coal-Fired generation	426 GWh	
Other non-renewables generation (waste)	1,832 GWh	
Total fossil fuel generation	53,703 GWh	39.9%

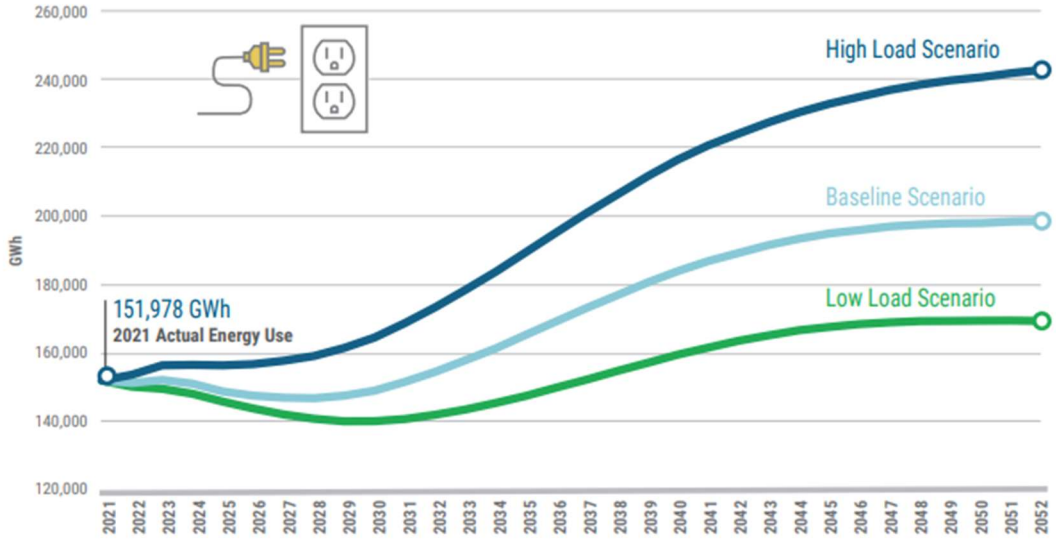
New York ISO – Power Trends 2022

Actual "energy use" 2021	151,978 GWh
a. "Low Load" Scenario, 2040	160,000 GWh
b. "Baseline" Scenario, 2040	185,000 GWh
c. "High Load" Scenario, 2040	215,000 GWh

2022 New York State Energy Profile – Net Electricity Generation

Existing "true renewable" generation *	1,020 GWh	(utility & individual solar & wind)
Hydropower generation	2,425 GWh	
Other renewables generation *	119 GWh	
Nuclear generation	3.4 GWh	
Total non-fossil fuel generation	3,567.4 GWh	42.4%
* True Renewables generation	1,139 GWh	13.5%
Natural Gas-Fired generation	4,824 GWh	
Petroleum-Fired generation	12 GWh	
Total fossil fuel generation	4,836 GWh	57.5%

Figure 6: **Electric Energy Usage - Actual and Forecast: 2021-2052 (GWh)**



a. "Low Load" Scenario – increased adoption of "energy efficiency measures" plus BTM Solar BTM solar is individual small-scale home or commercial solar installation that powers homes and businesses without requiring utility provided electricity.
b. "Baseline Scenario" – expected rate of load growth.
c. "High-Load Scenario" – assumes higher rates of adoption of electrification (EV's and home heating), plus reduced adoption of energy efficiency measures and BTM solar.

Addenda #48, June, 2024

Re: *Ch. 7, Carbon Emissions*

SDG 13 – Take urgent action to combat climate change and its impacts

Ch. 8, 2050 Net-Zero Emissions; Impossible!

SDG 7 – Ensure access to affordable, reliable, sustainable and modern energy for all

The battle against climate change in the European Union is not going exactly as climate alarmist politicians had planned. The U.N. Intergovernmental Panel on Climate Change (IPPC) set a target of limiting global warming to a total of 1.5° C above "pre-industrial levels" and reach net zero greenhouse gas emissions by 2050.
To reach this goal, the EU agreed in 2019 that it must reduce its carbon output by 55 per cent by the end of this decade, compared with 1990 levels.

The IPPCs first "scientific assessment" on Climate Change, published in 1990, used total net emissions of 4,649,770,440 kt (kilotons/1,000 tons) for a "baseline". According to the EU agreement, by 2030 total emissions must decline 55% to 2,557,373,742 kt.

As of 2016, when the Paris Climate Accord was ratified, emissions were 3,486,374,250 kt., for a decline of 25% over 26-years. As of 2022, net emissions had fallen to 3,138,341,494 kt., a decline of 32.5% over 32 years from 1990. Since the Paris Climate Accord was ratified, and countries began taking emissions reduction more seriously, emissions have fallen by 9.98% over 6 years. That's still only a reduction of 1.66% per year on average.
Source: European Environment Agency website; "EEA greenhouse gasses data viewer"

At this rate of decline, reaching a 55% reduction by 2030 is impossible. And reaching net zero emissions by 2050, is also impossible.
But scientific facts don't seem to matter to the European Scientific Advisory Board on Climate Change.

The Advisory Board recommends keeping the EU's greenhouse gas emissions budget (i.e. cumulative emissions) for the period 2030 to 2050 within a limit of 11-14 Gt CO_2e, in line with limiting global warming to 1.5 °C (with no or only limited and temporary exceedance of that temperature).
To achieve this, the EU must strive for net emissions reductions of 90-95% by 2040, relative to 1990 levels. These reductions are essential for mitigating climate risks and achieving a sustainable future.
EU climate Advisory Board recommends ambitious 2040 climate target and urgent transitions for the European Union: European Scientific Advisory Board on Climate Change, 14 Jun 2023

This even more unrealistic goal means that EU countries must reduce emissions more than 85% over an 18-year period. That's a reduction of 4.7% per year, or 283% more than they have been able to achieve to this point.

The original "Renewable Energy Directive", adopted on April 23, 2009, established that 20% of the EU's gross final energy consumption and 10% of each EU country's transport energy (vehicle) consumption must come from renewable energy sources by 2020. The directive required each EU country to develop their own plan for achieving their targets, submit their plans to the EU Parliament, and publish national renewable energy progress reports every two years.

In 2018, as part of the 'Clean energy for all Europeans' (European Green Deal) package, the Renewable Energy Directive was revised, establishing a new binding renewable energy target for the EU of at least 32% of gross final energy consumption by 2030, along with an increased target of 14% for the share of renewable fuels in transport by 2030.
In 2023 the Parliament approved a new renewable energy target of 42.5% by 2030 but urged EU countries to "strive for a 45% share."

According to a March 2024 report published by the European Environmental Agency, the share of energy consumed in the EU that was generated from renewable sources in 2022 was 23%; a 1.1% increase from the previous year. The analysis of the report stated:
Meeting the new target of 42.5% for 2030 will demand more than doubling the rates of renewables deployment seen over the past decade, and requires a deep transformation of the European energy system.
Share of energy consumption from renewable energy sources in Europe; European Environment Agency, March 27, 2024

Less than half of the twenty-seven EU countries exceed the combined average for renewable production. Countries with the highest renewable source production; Iceland +80%, Norway +70%, and Sweden +60%, have abundant sources of hydropower. The rest of the EU member states have to rely on increased generation from wind and solar sources.

Although this total RES share represents a historical high, the ***growth rate*** *of renewables has slowed since 2020…*
Doubling the rate of renewable energy production at a time when their growth rates are slowing, will be no easy task to achieve. The expense to EU countries will be enormous, and levels of debt will have to rise in order to fund the construction of new wind and solar farms. At the same time, the European Central Bank (ECB), is calling for further sovereign debt reduction and a "shift to fiscal discipline."

- *The EU emissions trading "scheme"*

The European Union "emissions trading system" (ETS) was launched in 2005. The *EU Emissions Trading Scheme* is described on the European Parliament website as follows:

"Launched in 2005, the emissions trading system (ETS), part of the Fit for 55 package, is one of the tools set by the EU to reach this goal. It specifically targets industry."

The trading scheme forces EU power plants and factories to buy permits for each ton of CO_2 they emit, forcing them to pollute less and accelerate the construction and use of renewable energy sources.
*"This should provide a **financial incentive to pollute less**: the less you pollute, the less you pay."*
But everyone knows that when businesses are faced with additional fees or surcharges, they will pass that increased cost of doing business onto their customers.

The original trading scheme had an allotment of "free allowances". Those allowances were used in national emergency situations to temporarily halt those fees, and, to prevent manufacturing moving to other parts of the world (China, India, etc.) that have laxer emission constraints. When parliament passed the *European Green Deal* in 2022, they set a target for cutting industry emissions 62% by 2030.
Parliament reduced the number of emissions permits available thru 2030, forcing power companies and factories to speed up the transition to renewables, and making the remaining permits more expensive.

The EU Parliament also decided to phase out free allowances by 2034 and set up a "carbon levy" on imported goods, to prevent companies moving to other parts of the world. Specific imports from countries that have "less ambitious" climate rules than the EU, will be subject to "carbon leakage" tariffs to level the playing field with EU manufacturers. Energy-intensive industries; iron, steel, aluminum, cement and fertilizers, will be charged for greenhouse gases emitted when the goods are produced until they are imported into the EU.
European Parliament Topics – Carbon leakage: preventing firms from avoiding emissions rules

"Having a large surplus and low prices discourages companies from investing in green technology, thereby hampering the scheme's efficiency in combatting climate change".

The EU government will collect the revenue from the tariffs and use it to help pay for renewable production. But tariffs also increase the price of imports, leading to higher prices for consumers. These increases will have a disproportionate effect on lower-income consumers, who will have to pay a higher percentage of their incomes on products made from those imported items.

Note: The EU also has a "Value Added Tax" (VAT) on nearly all goods and services that are bought and sold for use or consumption in the EU. A VAT is charged on all goods and services, at all stages from beginning to end of the production process. The consumer pays the final accumulated charge at the time of purchase.

Adding carbon leakage tariffs to the VAT burden will just make living in, and doing business with, European Union countries more expensive in the future.