Analyze
Impact of emission reduction policies 2022 comes to the manufacturing industry

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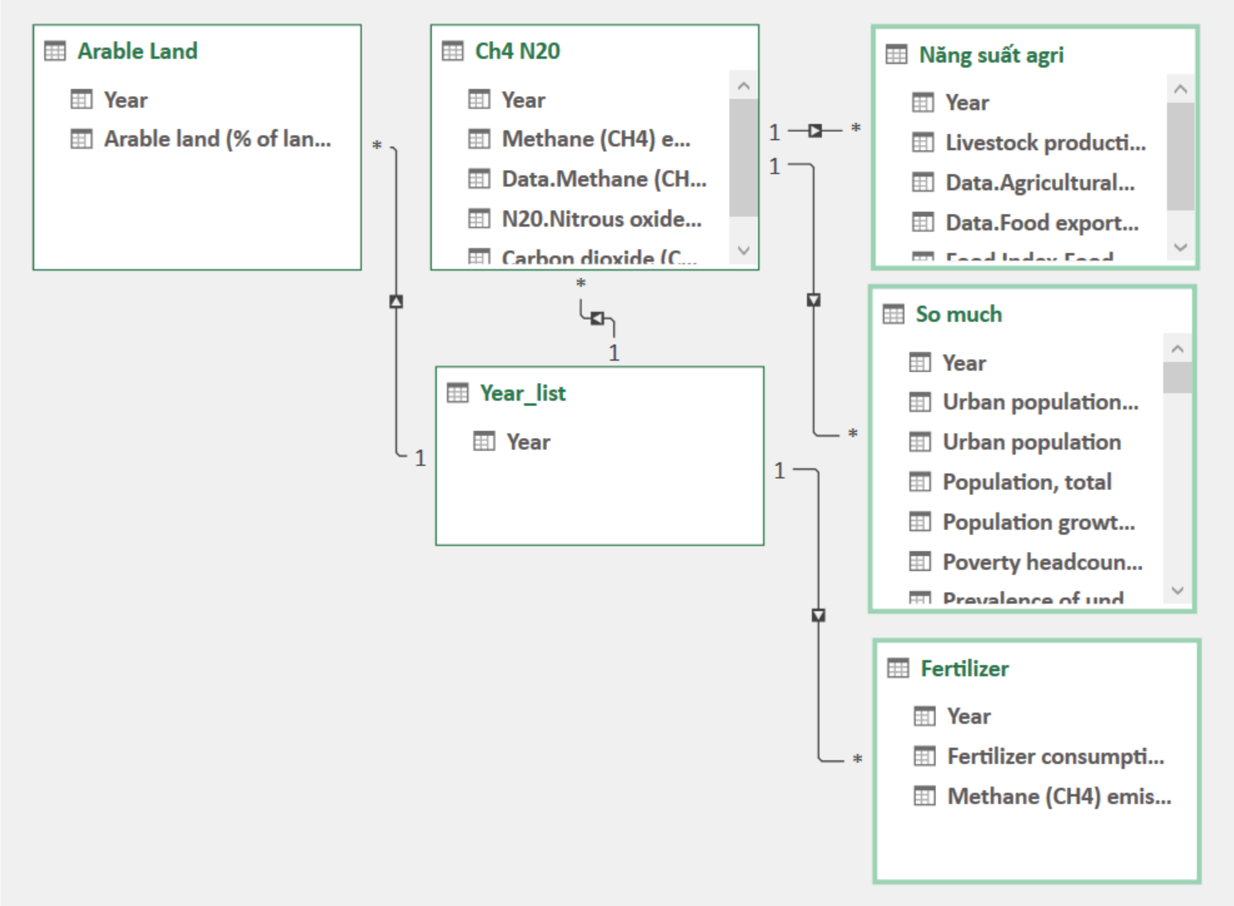
1.Problem Statement

Research question: How does the greenhouse gas emission reduction policy (2022) affect Vietnam?

Goals:

1. Analysis of CH_4, N_2O, CO_2 emission trends (1970–2023).
2. Evaluating the effectiveness of the Law on Emission Reduction 2022.
3. Propose a complete solution

2. Tools & Environment



- **Analysis tool:** Microsoft Excel
- **Skills:**
  - Statistics, Regression
  - Data Cleaning & Transformation
  - PowerPivot & Data Modeling
  - Visualization (Charts, Conditional Formatting)

3. Data Collection

Sources data:

- World Bank Data (WBD)
- Tổng cục Thống kê Việt Nam(GSO)
- Bộ Tài nguyên & Môi trường – Quyết định 2626/QĐ-BTNMT (2022)
- Source documentation: datasources

4. Exploratory Data Analysis

Summary Statistics:

- CH_4 has a high average; low standard deviation indicates stable data; slight positive skewness suggests some high outliers.
- N_2O has a lower average than CH_4; distribution is fairly symmetric with few extremes.
- CO_2 has the lowest average and is the most stable with minimal variation.

Livestock		*CH4*		*N2O*		*CO2*	
Mean	50.722	Mean	67.600	Mean	10.641	Mean	1.569
Standard Error	5.036	Standard Error	0.910	Standard Error	0.659	Standard Error	0.139
Median	32.550	Median	66.084	Median	11.317	Median	1.518
Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	0.225
Standard Deviation	37.007	Standard Deviation	6.688	Standard Deviation	4.843	Standard Deviation	1.024
Sample Variance	1369.485	Sample Variance	44.725	Sample Variance	23.455	Sample Variance	1.049
Kurtosis	-0.781	Kurtosis	-1.543	Kurtosis	-1.630	Kurtosis	-1.368
Skewness	0.769	Skewness	0.265	Skewness	-0.106	Skewness	0.182
Range	122.760	Range	20.714	Range	14.012	Range	3.207
Minimum	12.660	Minimum	57.215	Minimum	3.988	Minimum	0.204
Maximum	135.420	Maximum	77.929	Maximum	18.000	Maximum	3.411
Sum	2738.998	Sum	3650.411	Sum	574.637	Sum	84.725
Count	54	Count	54	Count	54	Count	54

Heatmap:

The highly correlated, indicating their emission trends move together over time.

This suggests that controlling one type of gas may also impact the others.

	Livestock	*CH4*	*N2O*	*CO2*
Livestock	1			
CH4	0.907	1		
N2O	0.892	0.945	1	
CO2	0.917	0.939	0.986	1

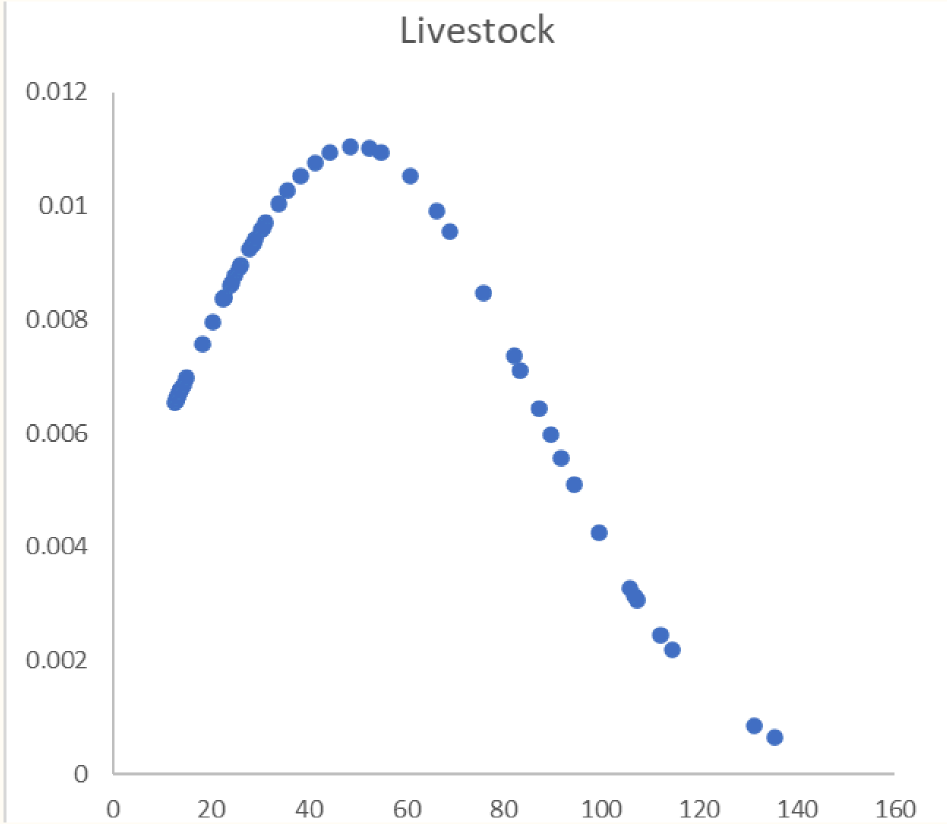
Key Insight

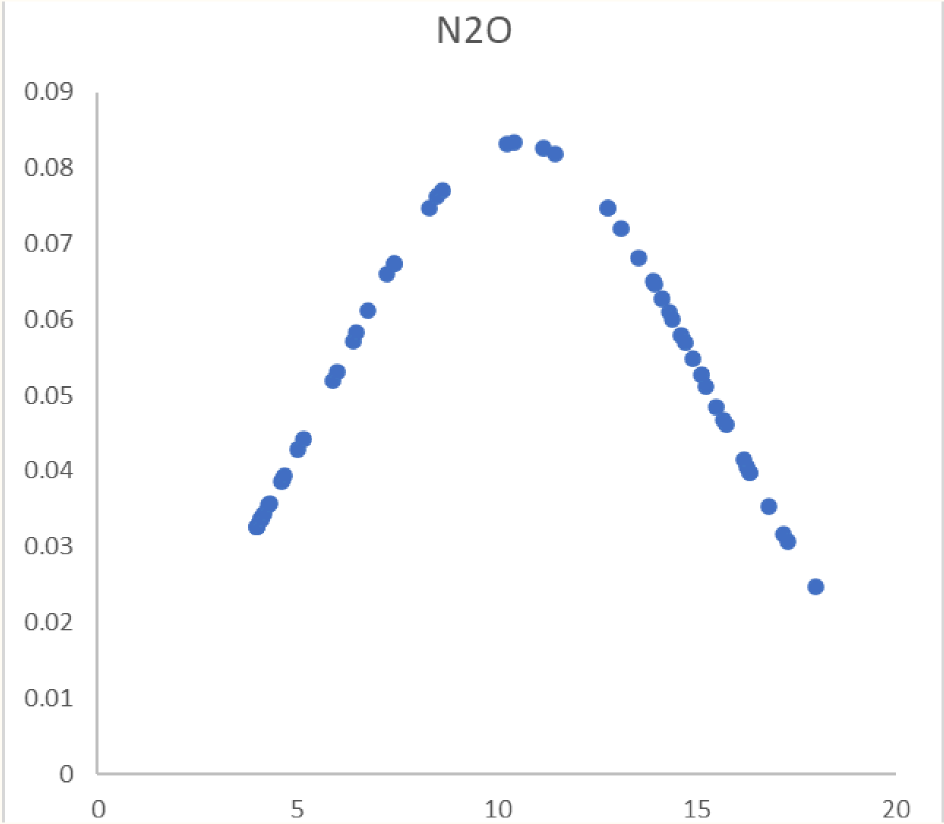
- CO_2 is stable → CO_2 is less volatile, which may be due to pre-existing control measures or insensitivity to livestock changes such as CH_4, N_2O.
- Livestock is strongly related → High correlation indicators with livestock indicate that the industry is a major source of emissions, with a focus on improving production processes and controls.

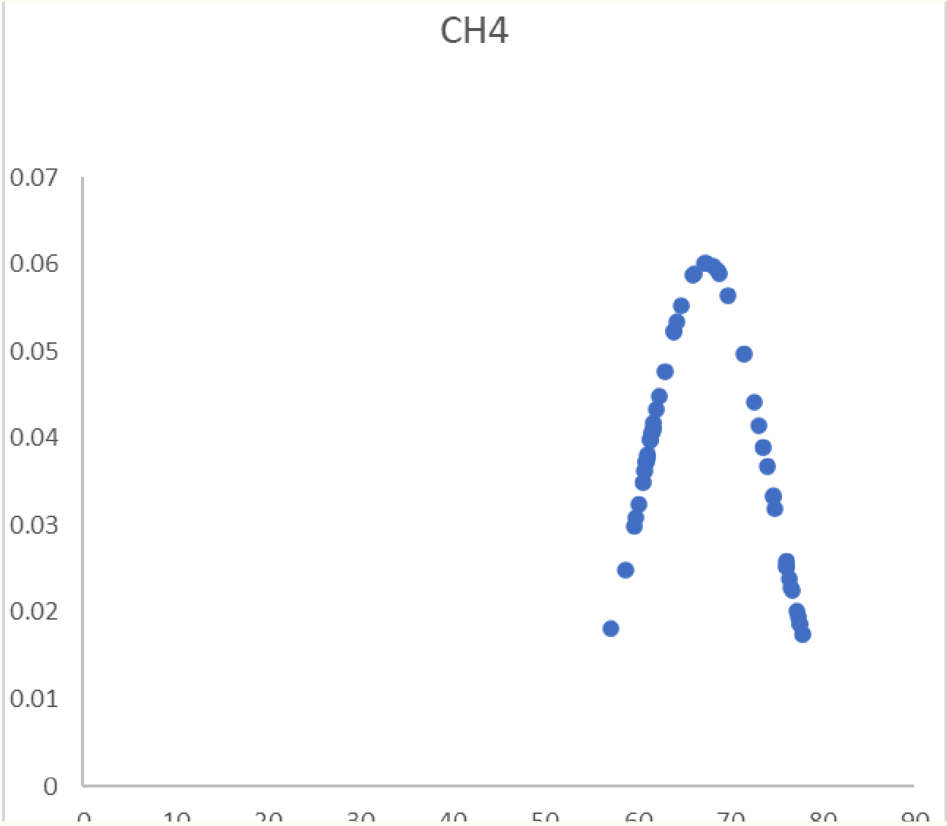
5. Modeling

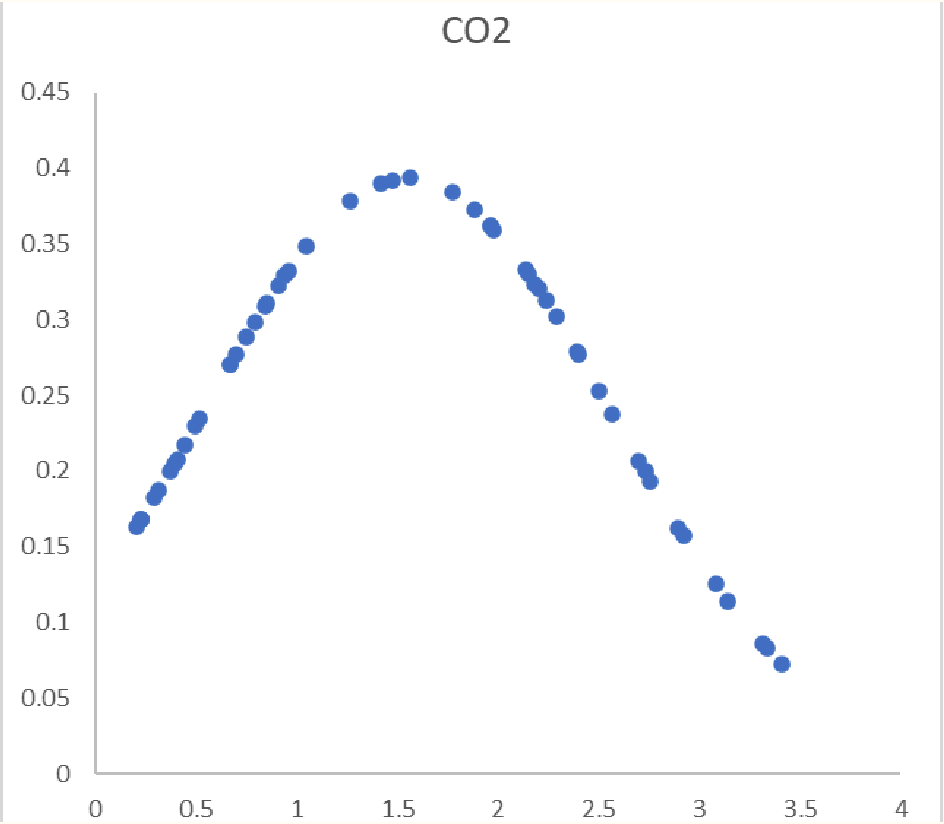
$$Y = \alpha + \beta_1 CH_4 + \beta_2 N_2O + \beta_3 CO_2 + \varepsilon$$

- Dependent Variable: Livestock Production Index
- Independent variables: CH_4, N_2O, CO_2









5. Modeling

Model Efficiency:

1.R^2 = 0.874, Adjusted R^2 = 0.866 → The model explains ~87.4% of the fluctuation of the livestock production index.

2.F-test ~0.00→ The model has overall statistical significance.

Meaning of each variable:

1.CH_4 (Methane) → Positive and meaningful effects.

2.N_2O (Nitrous oxide) → Negative effect, indicating that high emissions reduce production efficiency.

3.CO_2 (Carbon dioxide) → the strongest influence and is statistically significant.

Regression Statistics	
Multiple R	0.935
R Square	0.874
Adjusted R Square	0.866
Standard Error	13.547
Observations	54

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	63406.48451	21135.49484	115.1642758	0.00
Residual	50	9176.237457	183.5247491		
Total	53	72582.72196			

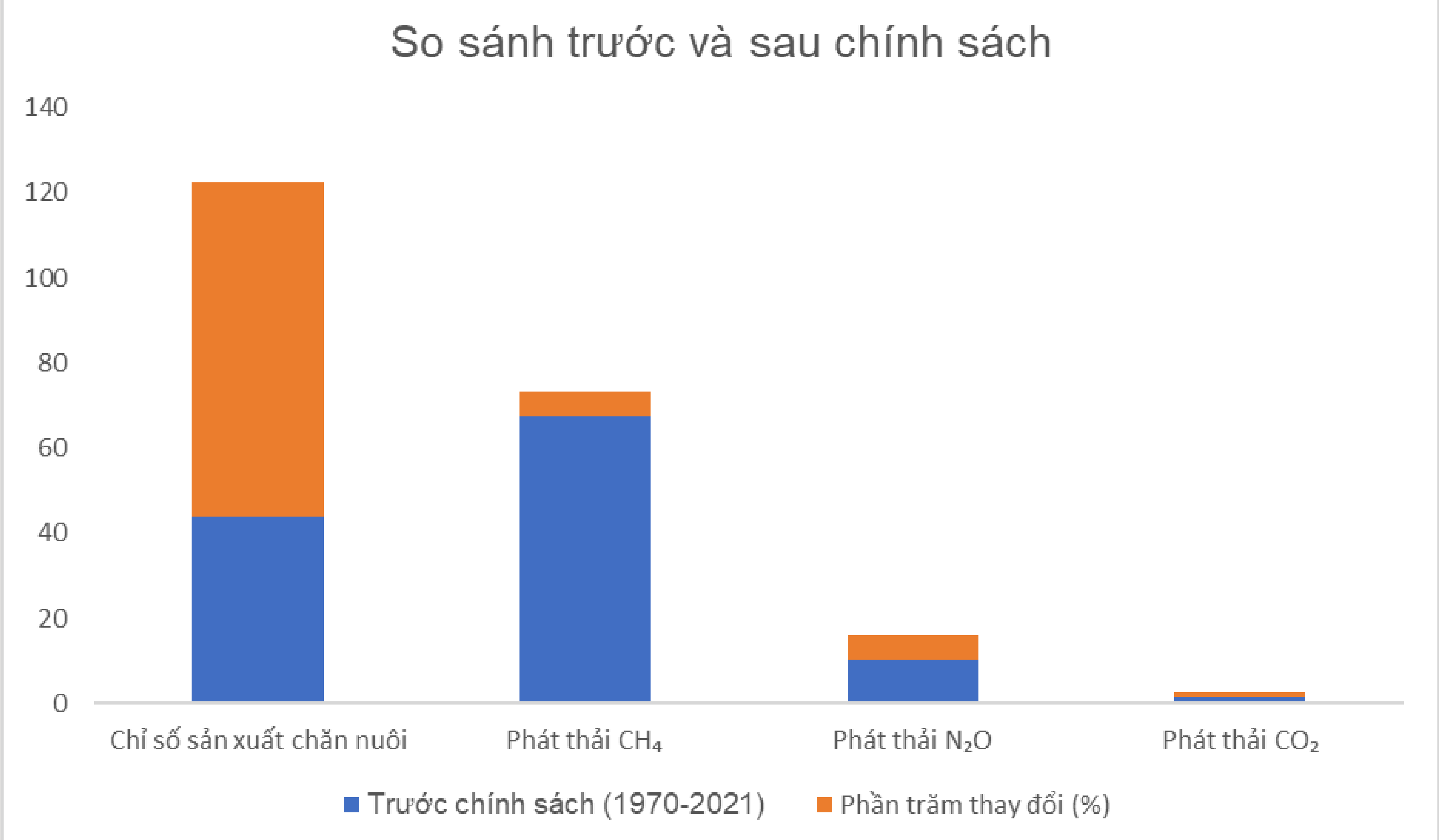
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-146.927	47.665	-3.082	0.003	-242.665	-51.189
CH4	2.862	0.856	3.345	0.002	1.143	4.580
N2O	-6.089	2.466	-2.469	0.017	-11.042	-1.135
CO2	43.968	11.104	3.959	0.000	21.664	66.272

Key Insight

- CO_2 is the most important forecasting factor for livestock production.
- CH_4 is also positively supportive, while N_2O may reflect a negative impact from poor management or environmental stress.

6. Policy Impact Analysis Before/after comparison

$$\text{Percentage change} = \frac{(\text{After Average Value} - \text{Previous Average Value})}{\text{Previous Average Value}} \times 100\%$$



Average Comparison Results

1.Livestock production increased sharply: +178.34%

2.Emissions also increased: CH_4 +8.57%, N_2O +59.16%, CO_2 +83.65%

→ Production increases faster than emissions, demonstrating somewhat better environmental efficiency.

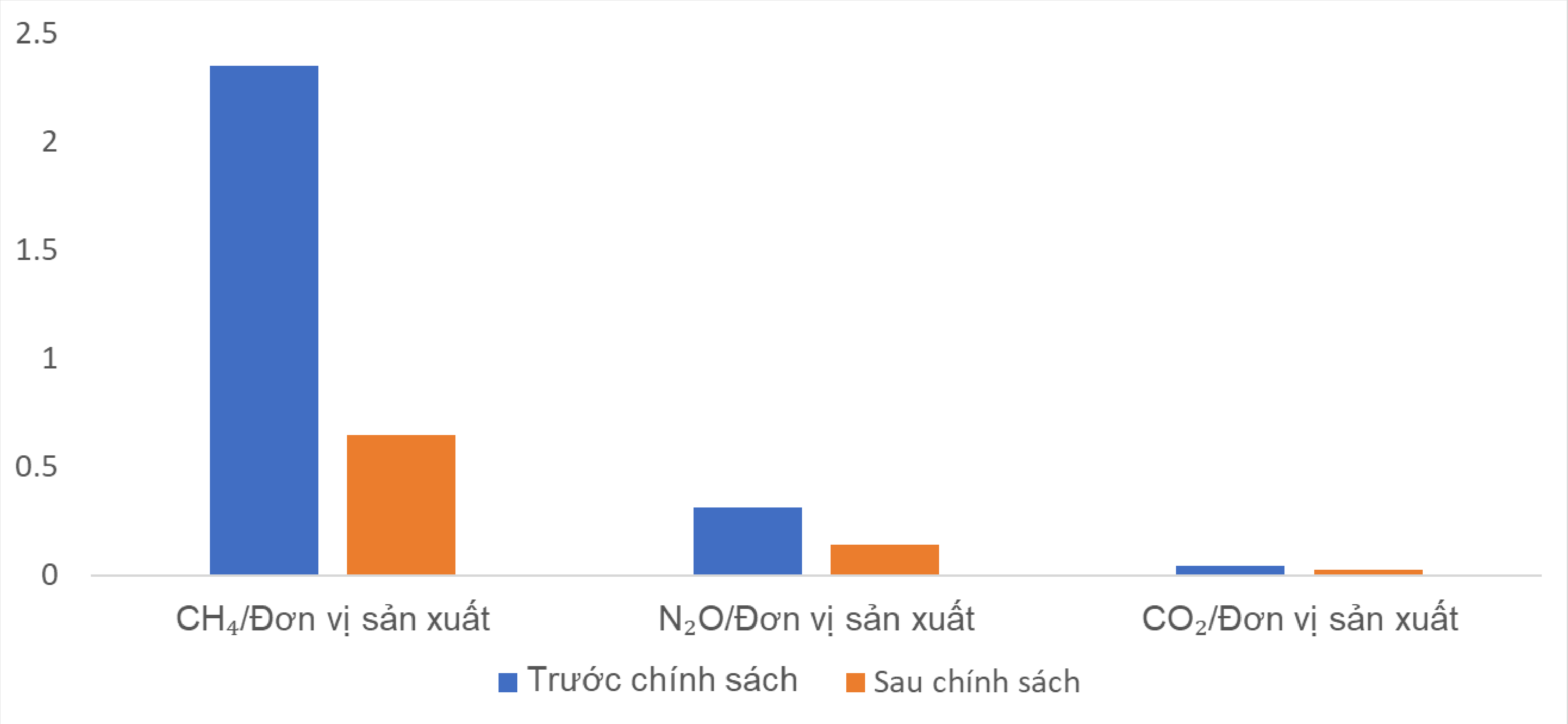
6. Policy Impact Analysis Emission Intensity change

This method calculates emissions per livestock production unit, providing an indicator of the environmental efficiency of the industry:

$$\boxed{\text{Emission intensity} = \frac{\text{Emissions}}{\text{Livestock production index}}}$$

Emission intensity is calculated separately for each type of gas (CH_4, N_2O, CO_2), then the average value before and after the policy is compared to assess the change in environmental performance.

$$\boxed{\text{Percentage change} = \frac{(\text{After Average Value} - \text{Previous Average Value})}{\text{Previous Average Value}} \times 100\%}$$



Emission Intensity:

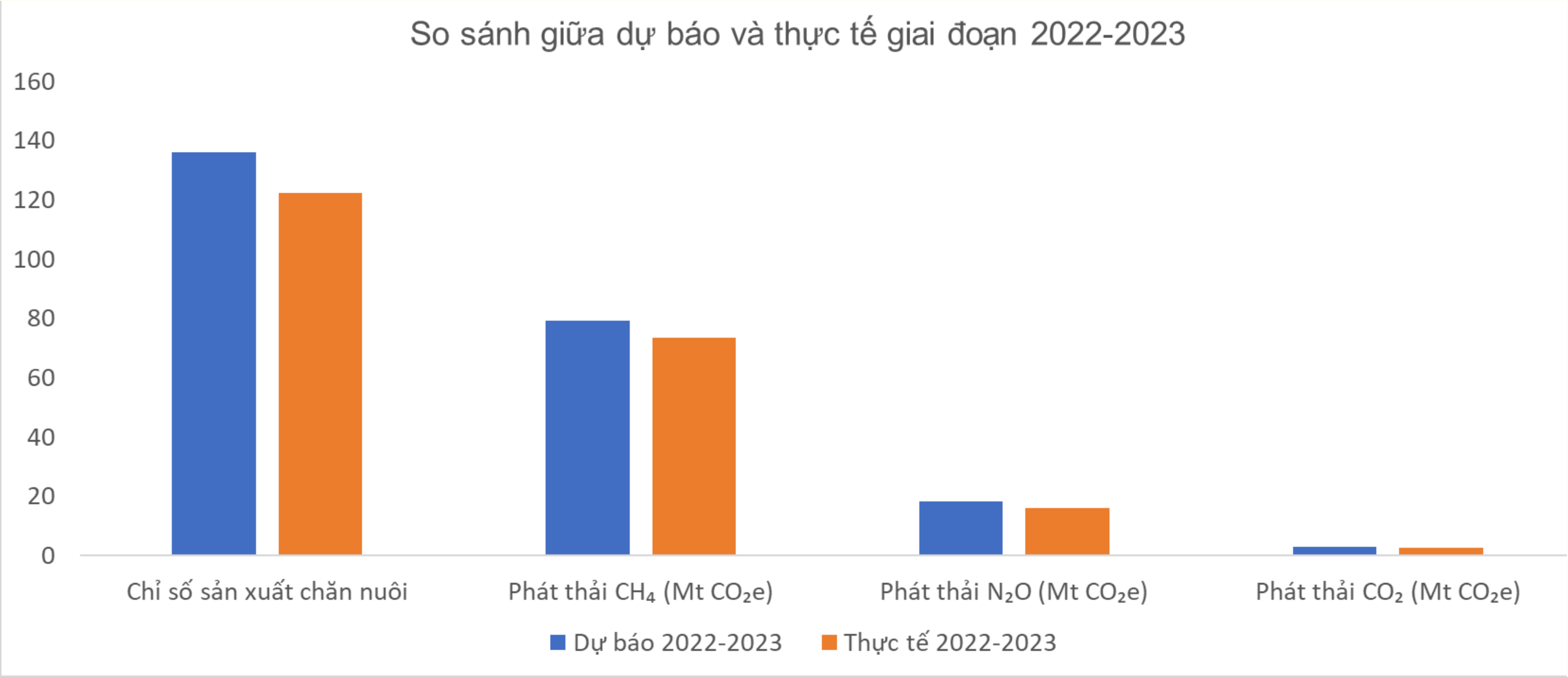
1. CH_4 down 72.52%
2. N_2O decreased by 55.71%
3. CO_2 decreased by 46.18%

→ shows that the livestock industry has become more environmentally efficient after the policy.

6. Policy Impact Analysis Counterfactual analysis

This method uses linear regression techniques to build a forecast model based on pre-2022 data:

1. Building a linear regression model for each variable based on 1970-2021 data
2. Forecast of the expected value for 2022-2023 according to the model (assuming no policy)
3. Compare the actual value with the forecast value to determine the difference



The 2022–2023 emissions forecast using a linear regression model from 1970–2021.

So data compared to reality → **negative differences** shows that the 2022 policy helps to **reduce emissions effectively.**

7. Results & Insights

Total emissions increase but environmental efficiency improves

→ Livestock production increased by 178%, but CH_4 only increased by 8.6%, N_2O increased by 59%, and CO_2 increased by 83%, proving that the rate of increase in production far exceeded the rate of increase in emissions.

Emission intensity drops sharply after policy 2022

→ CH_4/GDP decreased by –72.5%, N_2O decreased by –55.7%, CO_2 decreased by –46.2%, → testament to the effectiveness of the Law on Emission Reduction 2022.

Actual data is lower than forecast (counterfactual)

→ Actual CO_4 emissions were lower than the forecast of 5.98 Mt CO_2e, indicating that the policy has helped curb the increase in emissions.

Initial policy impact is effective, but long-term monitoring is needed

→ The trend of reducing emissions has appeared before 2022, it is necessary to distinguish it from policy influences; data from the following years are needed for a comprehensive assessment.