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PROJECT ON

Energy Consumption Analysis

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Business Problem Statement

- Analyzed global energy data such as consumption, production, emissions, GDP, and population.

- Studied how economic growth (GDP) is related to energy usage in different countries.

- Identified countries with very high energy consumption.

- Compared energy use and emissions to understand sustainability patterns.

- Helped highlight which countries use energy efficiently and which do not.

- The analysis can support government and policy decisions related to energy planning and environmental protection.
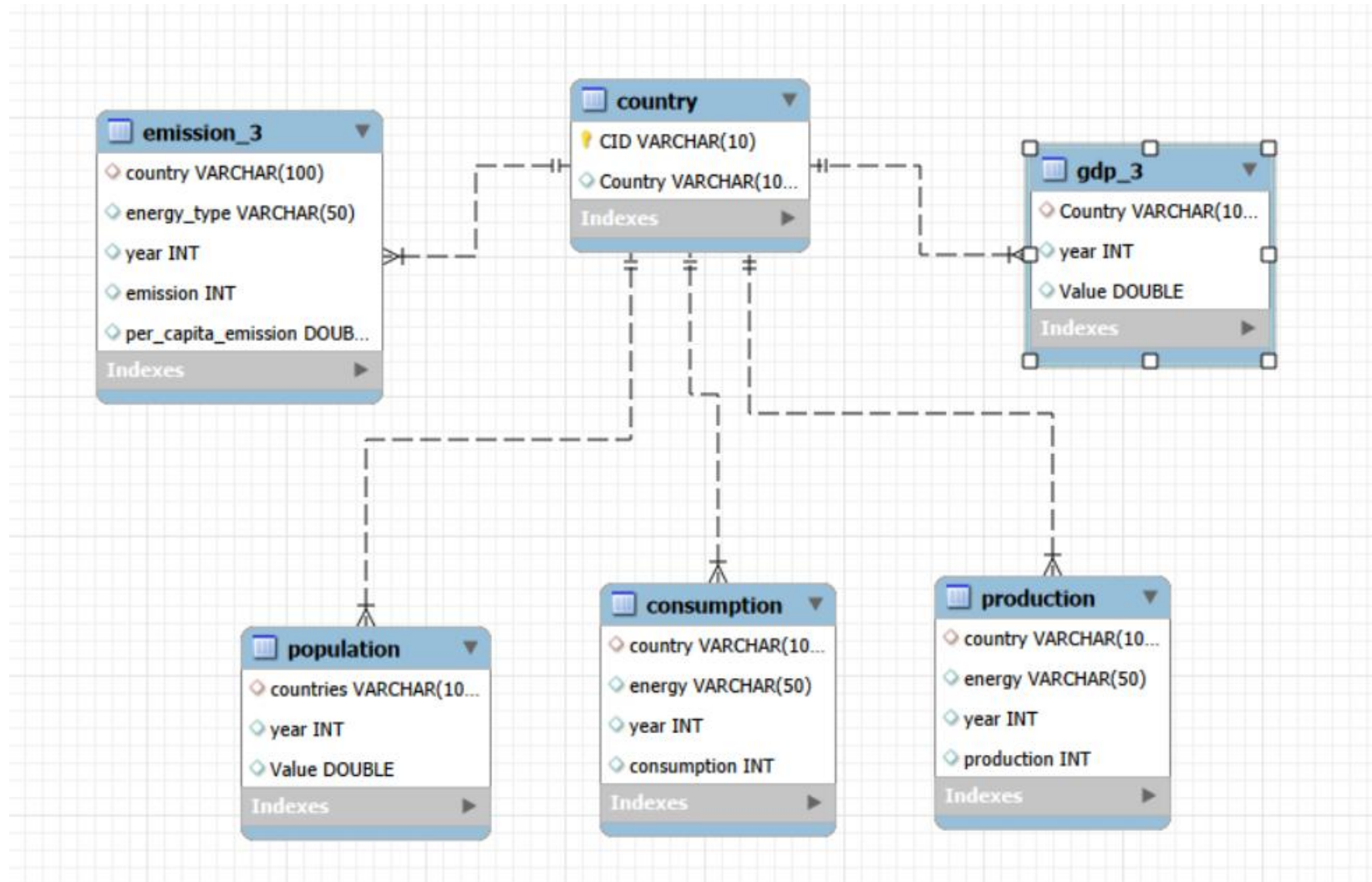
Introduction

- This project analyzes global energy data from different countries.
- The data includes energy consumption, energy production, carbon emissions, GDP, and population.
- MySQL is used to store and analyze the data.
- The project studies how energy usage is related to economic growth and population.
- It helps identify countries with high energy use and high emissions.
- The analysis supports better energy planning and sustainability decisions.

Dataset overview

- Country – Stores country IDs and country names.

- Emission_3 – Stores carbon emission data by country, year, and energy type (total and per-capita emissions).

- GDP_3 – Gross Domestic Product Stores GDP (PPP) values for each country by year.

- Population – Stores population data for each country by year.

- Consumption – Stores energy consumption data by country, year, and energy type.

- Production – Stores energy production data by country, year, and energy type.

Er Diagram

ER Relationshhips

- Country is the Central (Parent) Table

The country table acts as the main table. Other tables are connected to it using the country column (Foreign Key.

One-to-Many Relationship (Country → Emission)

One-to-Many Relationship (Country → GDP)

One-to-Many Relationship (Country → Population)

One-to-Many Relationship (Country → Consumption & Production)

Analysis questions

1. What is the total emission per country for the most recent year available?

```sql
# 1. What is the total emission per country for the most recent year available?
select country, sum(emission)
as total_emission
from emission_3
where year = ( select max(year) from emission_3)
group by country
order by total_emission desc;
```

country	total_emission
China	24392
United States	9590
India	5642
Russia	3688
Japan	1920
Indonesia	1659
Iran	1646
Saudi Arabia	1313
South Korea	1288
Germany	1200

- China has the highest total emissions in the most recent year, far exceeding all other countries.

- The United States and India are the next largest contributors, showing that major economies produce the most emissions.

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2. Which energy types contribute most to emissions across all countries?

```sql
select energy_type, sum(emission)
as total_emissions
from emission_3
group by energy_type
order by total_emissions desc;
```

energy_type	total_emissions
CO2 emissions (MMtonnes CO2)	142723
Coal and coke (MMtonnes CO2)	63945
Petroleum and other liquids (MMtonnes CO2)	47297
Consumed natural gas (MMtonnes CO2)	31469

• Coal and coke contribute the most to total emissions, making them the biggest polluting energy source.

• Petroleum and natural gas also add significant emissions, showing fossil fuels dominate global pollution.

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Trend Analysis Over Time

3. How have global emissions changed year over year?

```sql
select year, sum(emission) as total_emission,
sum(emission) - lag(sum(emission)) over (order by year) as Yoy_change
from emission_3
group by year
order by year;
```

year	total_emission	Yoy_change
2020	67852	NULL
2021	70976	3124
2022	72445	1469
2023	74161	1716

•Global emissions have increased steadily each year from 2020 to 2023, showing an overall upward trend.

•Year-over-year growth remains positive, indicating emissions are rising despite sustainability efforts.

4. How has population growth affected total emissions in each country?

```sql
select p.countries,p.year,
sum(e.emission) as total_emission,
sum(p.value) as total_values
from population as p
inner join emission_3 as e
on p.countries = e.country
group by p.countries, p.year
order by p.countries;
```

countries	year	total_emission	total_values
Afghanistan	2020	72	507896.73999999993
Afghanistan	2021	72	520005.3300000002
Afghanistan	2022	72	527524.9199999998
Afghanistan	2023	72	538911.88
Afghanistan	2024	72	554417.37
Albania	2020	30	45951.264
Albania	2021	30	45594.16000000002
Albania	2022	30	45241.728
Albania	2023	30	44986.47999999999
Albania	2024	30	44668.24

• Countries with rising populations generally show higher total emissions, indicating population growth contributes to emission increase.

• Emissions remain stable where population change is minimal, suggesting population size influences overall emission levels.gf

5. Has energy consumption increased or decreased over the years for major economies?

```sql
select country,year,
sum(consumption) as total_consumption
from consumption
where country in ('india','japan','Germany','China','United States')
group by country,year
order by country,year desc;
```

country	year	total_consumption
China	2023	177
China	2022	168
China	2021	165
China	2020	156
Germany	2023	11
Germany	2022	11
Germany	2021	13
Germany	2020	13
India	2023	38
India	2022	36

• China and India show a clear increase in energy consumption over the years, indicating growing energy demand.

• Germany and Japan remain mostly stable or slightly declining, suggesting slower growth or improved efficiency.

6. What is the emission-to-GDP ratio for each country by year?

```sql
select e.country, e.year,
sum(e.emission) as total_emission,
sum(g.value) as total_value,
sum(e.emission) / sum(g.value) as emission_to_gdp
from emission_3 e
join gdp_3 as g
on e.country = g.country and
e.year = g.year
group by e.country,e.year
order by e.country,e.year;
```

	country	year	total_emission	total_value	emission_to_gdp
▶	Afghanistan	2020	18	332.8658	5.407584678269742
	Afghanistan	2021	20	197.87481	10.107400734838356
	Afghanistan	2022	18	185.52708	9.70208769523026
	Afghanistan	2023	16	176.71935	9.053903831131112
	Albania	2020	6	147.15008	4.077469750611077
	Albania	2021	8	160.19048	4.994054578024861
	Albania	2022	9	167.97116	5.35806265789913
	Albania	2023	7	174.52688	4.010843487261102

• Countries with similar GDP produce very different amounts of emissions—how you generate energy matters more than how rich you are.

• Emission levels go up and down year to year, showing that economic changes and new policies quickly affect how clean a country's economy is.

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7. What is the energy consumption per capita for each country over the last Years?

```sql
select c.country, c.year,
sum(c.consumption) / sum(p.value)
as energy_per_capita
from consumption c
join population p
on c.country = p.countries and
c.year = p.year
group by c.country, c.year
order by energy_per_capita desc;
```

country	year	energy_per_capita
Qatar	2023	0.00016783693768751583
Singapore	2021	0.00012115751221706918
Qatar	2020	0.00011890429690402937
Qatar	2021	0.00011841401946205459
Singapore	2022	0.00011740863641492259
Qatar	2022	0.00011524235755900553
Bahrain	2020	0.00011320894839754998
Trinidad and Tobago	2020	0.00011253475073102576
Trinidad and Tobago	2021	0.00011202847494964879
Trinidad and Tobago	2022	0.00011141408314119975

• Rich countries like Qatar and Singapore use way more energy per person than others—wealth and development drive higher energy demand.

• Energy use per person stays fairly stable over years in the same countries, showing consumption patterns are hard to change quickly.

8. What are the top 10 countries by population and how do their emissions compare?

```sql
select p.countries,
sum(p.value) as total_population,
sum(e.emission) / sum(p.value) as emissions_per_capita
from population as p
join emission_3 as e
on p.countries = e.country
and p.year = e.year
group by p.countries
order by total_population desc
limit 10;
```

countries	total_population	emissions_per_capita
China	22801232	0.004049693455160669
India	22721260	0.0008900474709589169
United States	5334912.8	0.00720780290916845
Indonesia	4446374.800000001	0.0011949060164698664
Pakistan	3862739.2000000007	0.00042456917619496543
Nigeria	3534237.1999999997	0.0002472952296467255
Brazil	3358632.8000000007	0.0010138053793793371
Bangladesh	2699235.1999999993	0.00033120492797367206
Russia	2332911.5999999996	0.0062072647775913499
Mexico	2051200	0.0016653666146645865

• India has the largest population but one of the lowest emissions per person—showing population size doesn't equal high individual pollution.

• Top populated countries like Pakistan and Bangladesh have similar low per-capita emissions, proving crowded nations can still be relatively clean per person.

9. What is the global average GDP, emission, and population by year?

```sql
select g.year,avg(g.value) as avg_gdp,
avg(e.emission) as avg_emission,
avg(p.value) as avg_population
from gdp_3 as g
join emission_3 as e
on g.country = e.country
and g.year = e.year
join population as p
on e.country = p.countries
and e.year = p.year
group by g.year;
```

year	avg_gdp	avg_emission	avg_population
2020	629.0274965879078	85.3955	39656.202315365175
2021	671.0425053881465	89.4439	39986.5686607818
2022	694.6001345356871	91.2926	40345.80627994948
2023	717.9255333412348	93.4552	40711.65565397224

• Global GDP grew from 96T to 107T (2022-2023), while emissions stayed steady around 40B tons—showing economic growth doesn't always mean more pollution.

• World population hit 8B+ recently, but average emissions per person remain stable, proving cleaner tech can balance growing numbers.gf

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Overall Business Insights

- Global emissions and energy use are rising over time, mainly in major economies.
- Countries with higher population and GDP generally produce more emissions.
- Some countries have a high emission-to-GDP ratio, showing lower energy efficiency.
- Energy consumption has increased across most major economies in recent years.
- Governments and businesses should invest in renewable energy and efficiency to reduce emissions while supporting economic growth.

Recommendations

- Increase the use of renewable energy to reduce dependence on fossil fuels.
- Improve energy efficiency in industries and households.
- Focus emission-reduction efforts on high-emission countries and sectors.
- Promote policies that support low-carbon economic growth.
- Use data monitoring regularly to track progress and adjust strategies.

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Conclusion

- Global emissions have shown a steady increase over the years.
- Fossil fuels remain the largest contributors to total emissions.
- Economic and population growth are strongly linked with higher emissions.
- Energy consumption continues to rise in major economies.
- Sustainable energy policies are essential to balance growth with environmental protection.

Challenges faced

- Joining large tables correctly by country and year required careful query design.
- Writing complex SQL queries (subqueries, joins, aggregations) was difficult at first.
- Managing large datasets sometimes affected query performance and execution speed.

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