CP-302 Mid Semester Evaluation

Carbon footprint predictor for film production, OTT platform

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Content

The film and entertainment industry is also a massive contributor to GHG emissions

Films and TV series

- Average carbon footprint of a movie was 3,370 metric tons or about 33 metric tons per shooting day.
- One-hour scripted dramas had 77 metric tons of CO_2 emissions per episode

average total emission of tentpole film per feature

utilities 22.0%

housing 6.0%

air travel 24.0%
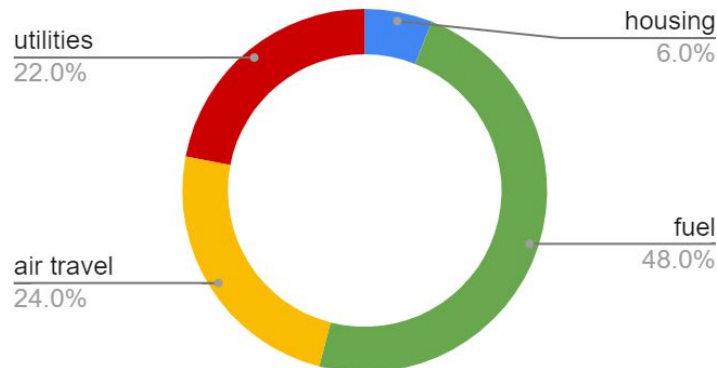
fuel 48.0%

Emission factors

- Air travel – 24%
- Fuel - 48%
- Utilities - 22%
- Housing- 6%

source

The film and entertainment industry is also a massive contributor to GHG emissions

Energy consumption at data center , data transmission and devices
(KWh/hr)

50" TV, WiFi, 4K, Laptop, WiFi, HD and Phone, 4G, 'Auto'

■ 50" TV, WiFi, 4K   ■ Laptop, WiFi, HD   ■ Phone, 4G, 'Auto'
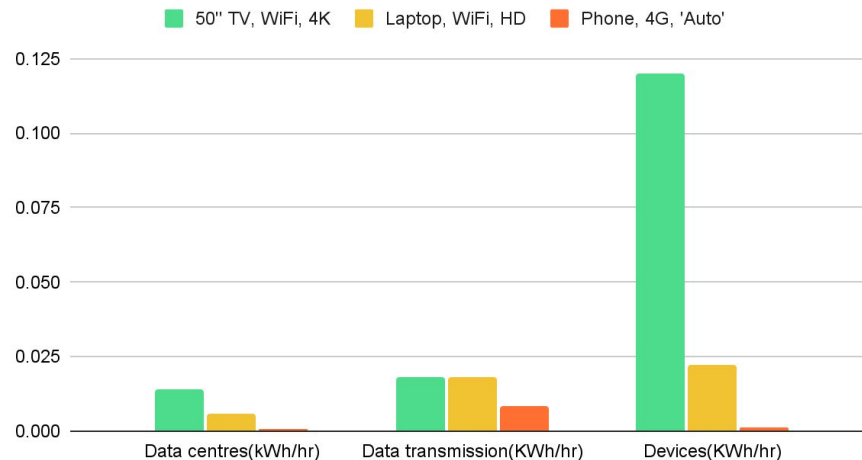
In 2020, the worldwide data centre electricity usage was **200-250 TWh**, or around **1%** of global final electricity demand. In 2020, data transmission networks consumed **260-340 TWh** globally, accounting for **1.1-1.4 %** of worldwide power consumption.[1]

Resource which I used for the project

Excel

- To do basic calculation
- To verify the obtained result
- Plots shown in the presentation are generated in excel.

Python

- To make the model

To produce a conclusion or result, I used data from a literature survey and analysed it.

| **Reading the literature**	**Sorting the content**	**Coming to conclusion**
• First I researched about the carbon footprint caused due to film industry, OTT & by Internet. • I tried to collect relevant data.	• Sorted the research paper and the data.	• Using the literature and the data, calculated the results.

Some interesting figures

- World produces 50 billion tonnes of GHG emissions annually
- The internet generates about 3.7% of global greenhouse emissions.
- 1% increase in internet users will result in a 0.026 percent rise in electricity use.
- 3700 acres of forest absorbs around 2880 tonnes of CO_2 in one year.
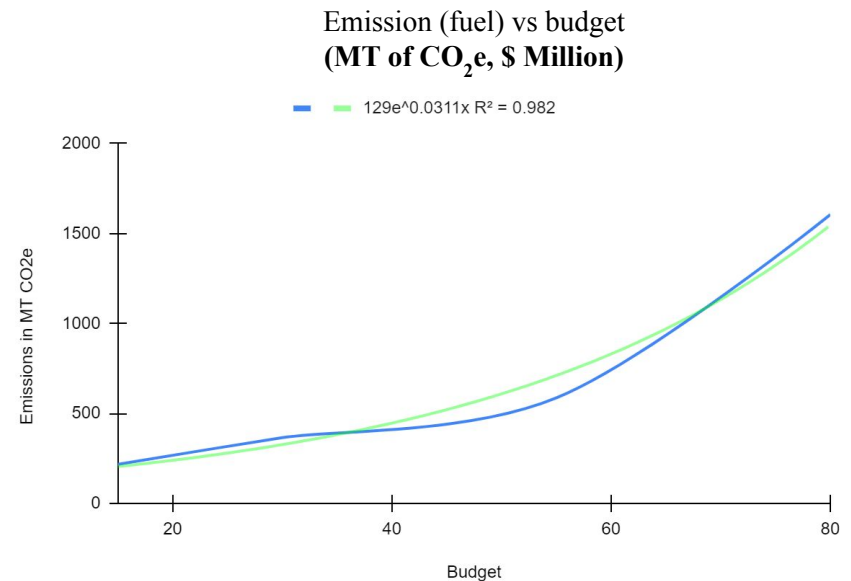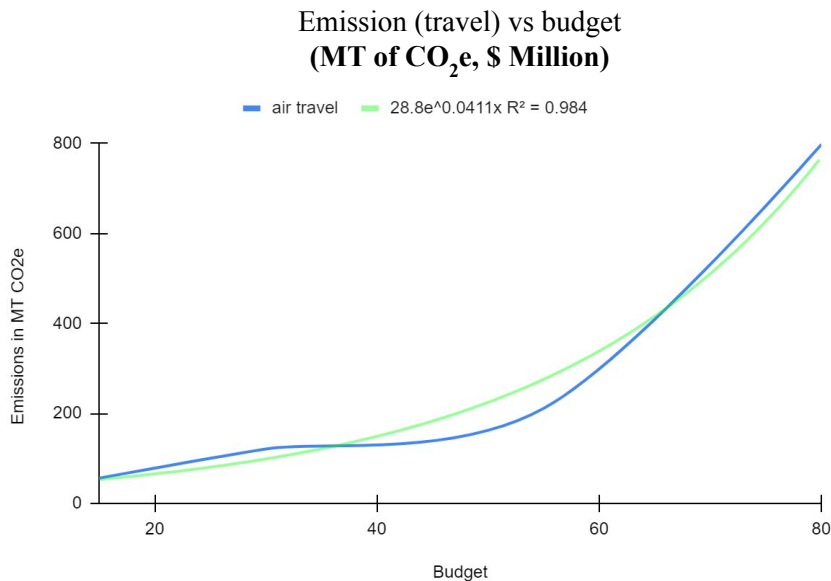
source

Methodology / Literature Survey

Using the tentpole data, I plotted the curve for each feature (emission from housing vs different sized movies, emission from fuel vs for different sized movies) and set a trend line which depicts the original curve best. Using the equation of these trend lines, I created a Python model which can predict the CO2e emissions from different budget movies.

Emission from movie production vs budget
(MT of CO$_2$e, \$ Million)
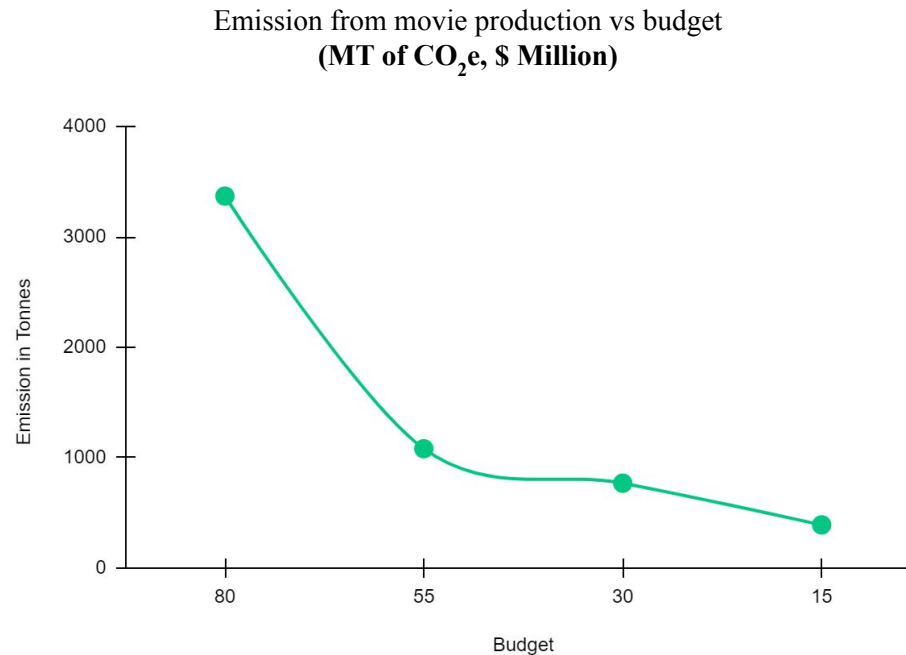
The analysis of the carbon emission intensity of streaming video and movie production presented in this piece is based on a range of sources and assumptions, calculated for 2019 or the latest year possible.

Source: SPA carbon emission

CO2 emissions from film production are caused by a variety of factors.

Using the data from these plots, a calculation is performed to calculate the emission for a movie with a specific budget while taking into account the various factors that contribute to emision.

Emission (travel) vs budget
(MT of CO_2e, $ Million)

— air travel — 28.8e^0.0411x R² = 0.984

Emissions in MT CO2e

Budget

Emission (fuel) vs budget
(MT of CO_2e, $ Million)

— 129e^0.0311x R² = 0.982

Emissions in MT CO2e

Budget

For tentpole production, air travel consumption made up nearly 24% of the average footprint. To reduce the emissions from travel, avoiding air travel as much as possible would be a good way to start.

For tentpole production, fuel consumption made up nearly 48% of the average footprint. Electrical grid tie-ins lessen the demand for diesel generators in terms of fuel consumption. Local governments and utilities can manufacture these on a temporary, installation, or permanent basis.
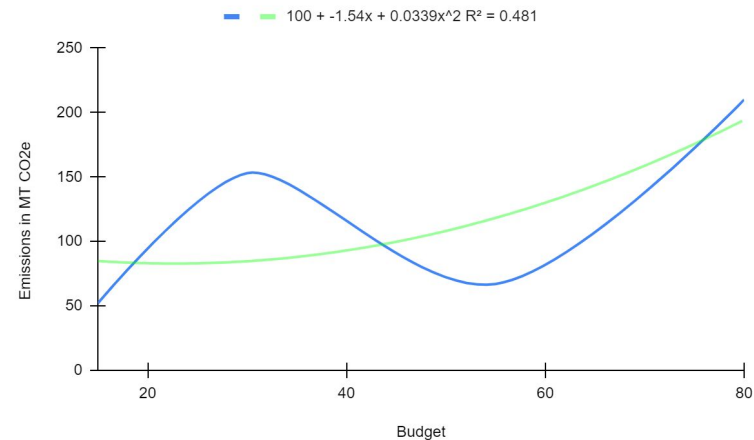
Different factors contribute to CO_2e emission in a movie production.

Using the data from these plots, a calculation is performed to calculate the emission for a movie with a specific budget while taking into account the various factors that contribute to emision.

Emission (utilities) vs budget
(MT of CO_2e, $ Million)

— 35e^0.0379x R² = 0.982

Emissions in MT CO2e
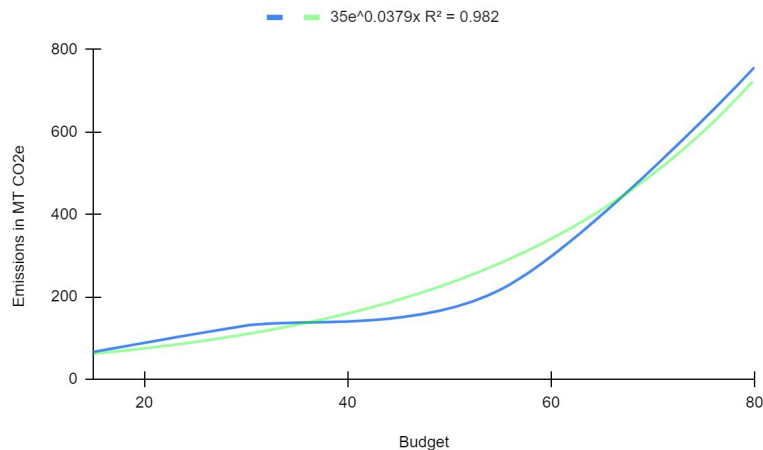
Budget

Emission (housing) vs budget
(MT of CO_2e, $ Million)

— 100 + -1.54x + 0.0339x^2 R² = 0.481

Emissions in MT CO2e

Budget

For tentpole production, utilities consumption made up nearly 22% of the average footprint. Sustainable production also prioritises energy efficiency. The rapid advancement and general acceptance of LED lighting for production in recent years has greatly decreased power demand on set.

For tentpole production, housing consumption made up nearly 6% of the average footprint. Housing contributes the least to emissions relative to other factors.

Emission from playing an online video

Energy impact(kWh) = Time spend on the internet action(min) × Device Impact + data size × (Device impact + Network impact)

CO_2 emission
(Kg/day/person)

IEA average (updated), 50'' TV, WiFi, 4K, Laptop, WiFi, HD and Phone, 4G, 'Auto'

■ IEA average (updated)   ■ 50'' TV, WiFi, 4K   ■ Laptop, WiFi, HD   ■ Phone, 4G, 'Auto'

	Data center (Kg CO2/Day)	Data transmission (Kg CO2/Day)	Devices (Kg CO2/Day)

CO2 emission Kg/day/person
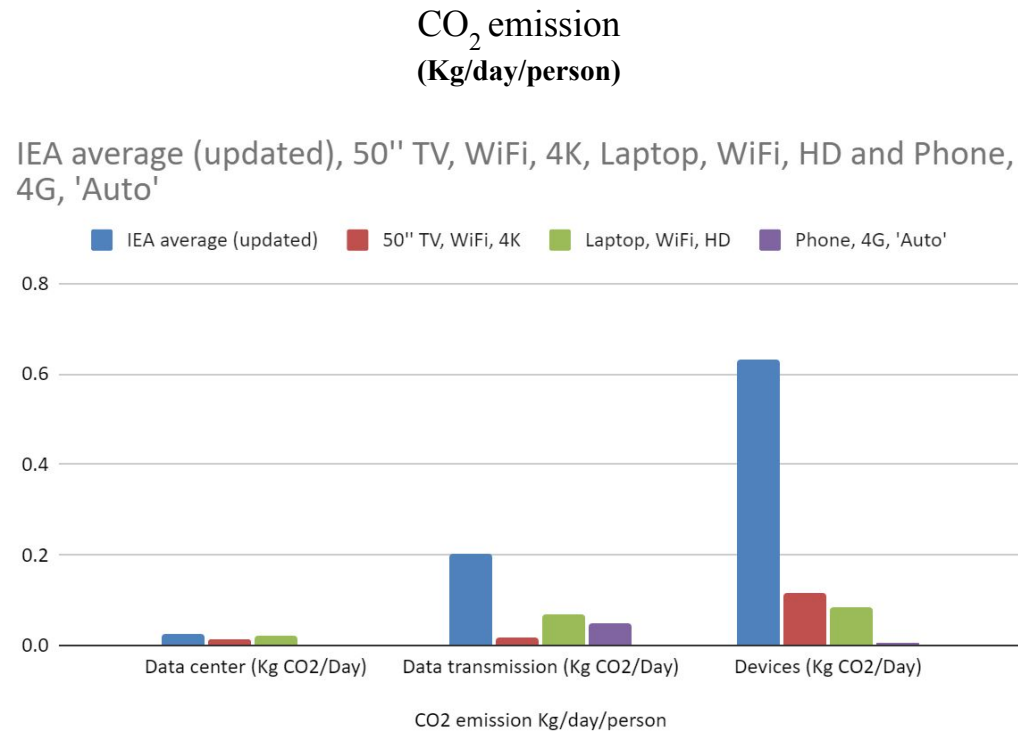
0.95Kg/KWh CO2e is produced in the generation of per KWh energy. We need to build more green data centres, renewable energy, and energy-efficient internet usage because it is impossible to limit internet users. In order to attain sustainability goals, it is critical to track performance.

Results

- A Python model was generated to calculate the total emission from movie production to its streaming on an online platform.
- Calculated the carbon emission from the data centre, data transmission and devices

What results will we find in the model?
- Total emission
- Emission from 4 different features
- Carbon emission from streaming
- And the relationship between total emissions calculated from the model and emissions from real-world activity.

Results

CODE

Importing the Libraries

```python
import pandas as pd
```

+ Code

Taking the input from the user

```python
movieTime    = float(input("please enter the time of the movie (in hour) :"))
movieBudget = float(input("please enter the budget of the movie (in million Dollar) :"))
device = ["50inchTV", "laptop", "phone"]
network = ["wifi", "wifi", '4G']
resolution = ["4k", "HD", "Auto"]
print("Please select an option you are using to watch the movie : ")
for i in range (3) :
  print("    ", i, ")", device[i], network[i], resolution[i])
choice = int(input())
```

```
please enter the time of the movie (in hour) :2
please enter the budget of the movie (in million Dollar) :80
Please select an option you are using to watch the movie :
     0 ) 50inchTV wifi 4k
     1 ) laptop wifi HD
     2 ) phone 4G Auto
2
```

First we import the panda library. Then we take input from the users such as length of the movie, budget of the movie, and the set up user is using to watch the movie.

Results

CODE

Data Preprocessing

```python
[ ] data = pd.read_csv("/content/data.csv").set_index("Unnamed: 0").iloc[:, :].values

[ ] def getCarbonEmsion(choice, movieTime, no_of_viewers = 1) :
        energyConsumption = movieTime*(data[0][choice] + data[1][choice]  + data[2][choice])
        carbonEmision = energyConsumption*0.95    # Inf producting 1Kwh 0.95 kg of carbon is produced
        return carbonEmision*no_of_viewers

    import math
    def getHousingEmission(x) :
        return int(100 - 1.54*x + 0.0339*(x**2))

    def getAirTravelEmission(x) :
        return int(28.8 * math.exp(0.0411*x))

    def getfuelEmission(x) :
        return int(129* math.exp(0.0311*x))

    def getUtilitesEmission(x) :
        return int(35 * math.exp(0.0379*x))

    def getTotal(x) :
        return int(239 * math.exp(0.0325 * x))
```

After taking the input, we use the Panda library to scan the csv file which has the data we need. Then we add the equation from Excel and use it to calculate the emission from movie production.

Results

CODE

Performing the Calculations

```
[ ]  print("Total Carbon Emission in making of the movie (in tons):", getTotal(movieBudget))
     print("Housing Carbon Emission in making of the movie (in tons):", getHousingEmission(movieBudget))
     print("Air travel Carbon Emission in making of the movie (in tons):", getAirTravelEmission(movieBudget))
     print("Utilities Carbon Emission in making of the movie (in tons):", getUtilitesEmission(movieBudget))
     print("Fuel Carbon Emission in making of the movie (in tons):", getfuelEmission(movieBudget))

     Total Carbon Emission in making of the movie (in tons): 3217
     Housing Carbon Emission in making of the movie (in tons): 193
     Air travel Carbon Emission in making of the movie (in tons): 771
     Utilities Carbon Emission in making of the movie (in tons): 725
     Fuel Carbon Emission in making of the movie (in tons): 1552

[ ]  print("The carbon Emission in seeing the movie (in kg/person) : ", getCarbonEmsion(choice, movieTime))

     The carbon Emission in seeing the movie (in kg/person) :  0.01938

 ▶   # number of viewers
     no_of_viewers = int(input("Please enter the number of the user : "))
     print("The carbon Emission in seeing the movie (in kg) : ", int(getCarbonEmsion(choice, movieTime, no_of_viewers)))

 ⤷   The carbon Emission in seeing the movie (in kg) :  669
```

Here we got the result for the equation which we used above. We printed it. Then we also calculated the emissions from watching the movie on a specific set up.

Results

CODE

```
totalEmission =  getTotal(movieBudget)*1000 + getCarbonEmsion(choice, movieTime, no_of_viewers) # have to check the unit
print("total emission is",int(totalEmission),"Kg")
print("This is equivalent to greenhouse gas emissions from",  int(totalEmission * 0.0002) ,"gasoline-powered passenger vehicles driven for one year.")
print("This is equivalent to CO2 emissions from",  int(totalEmission*0.0001), "homes energy use for one year.")
print("This is equivalent to carbon sequestered by", int(totalEmission*0.001), "acres of U.S. forests in one year.")
```

```
total emission is 3217669 Kg
This is equivalent to greenhouse gas emissions from 643 gasoline-powered passenger vehicles driven for one year.
This is equivalent to CO2 emissions from 321 homes energy use for one year.
This is equivalent to carbon sequestered by 3217 acres of U.S. forests in one year.
```

We print the equivalent amount of emissions generated by various daily activities that were originally generated in movie production as well as online movie viewing.

Example result:
    Assumption:
    Movie time = 2
    Movie budget = $80million
    Device=phone, network=4G, resolution= Auto
    Number of viewers = 34543

Results

Results:

- Carbon emission from movie production
  - Total emission of CO_2e is 3217669 Kg
  - Emission from 4 different features
    - Housing Carbon Emission in making of the movie (in tons): 193
    - Air travel Carbon Emission in making of the movie (in tons): 771
    - Utilities Carbon Emission in making of the movie (in tons): 725
    - fuel Carbon Emission in making of the movie (in tons): 1552
- Carbon emission from streaming
  - The carbon Emission in seeing the movie (in kg) : 669
  - This is equivalent to greenhouse gas emissions from 643 gasoline-powered passenger vehicles driven for one year.
  - This is equivalent to CO2 emissions from 321 homes' energy use for one year.
  - This is equivalent to carbon sequestered by 3217 acres of U.S. forests in one year

Conclusion

The most pressing global issue we face now is climate change. Everything we do in our daily lives has an environmental impact. Human awareness and corporate social responsibility are critical for long-term sustainable improvement

We need immediate plans to reduce the carbon footprint of video streaming industries and film making industries.

To reduce the carbon footprint of streaming industries we can
- Improve data collection and transparency:
- Commit to efficiency and climate targets and implement measures to achieve them
- Increase the energy efficiency and flexibility of data centre operations
- Invest in RD&D for efficient next-generation computing and communications technologies

To reduce the carbon footprint of film making industries we can:
- identify ways to convert film and television productions from fossil fuels to clean, renewable energy sources
- electric and hybrid rental vehicles, are increasingly in demand by production, and more sustainable fuels, such as renewable diesel, can be used as interim solutions until electric vehicle (EV) technology is fully developed for heavy-duty vehicles required for production.

We need to build more green data centres, renewable energy, and energy-efficient internet usage because it is impossible to limit internet users. In order to attain sustainability goals, it is critical to track performance. In addition, research and innovation are required to improve current technology so that it can assist environmental sustainability.

Thank You