production_eda

May 6, 2021

[1]:
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##########################
# Math380 Final Project
# Model Exploration
##########################

#%% import pyplot
from matplotlib import pyplot as plt
import numpy as np
import pandas as pd
```

[2]:
```
#%% PRODUCTION

start_OP = 5964297
start_RP = 2120823.171
```

[3]:
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#%%
# actual: OP growth > RP growth & OP's i-factor < RP's i-factor
OP = [start_OP]
RP = [start_RP]
n = np.arange(31)
# growth factor of oil production
a = 0.1372710762

# growth factoer of renewable energy production
b = 0.041262958

# interaction factor of OP and RP for OP
c = -0.0000000399281668

# interaction factor of OP and RP for RP
d = -0.00000001586660302

for i in range(30):
    OP.append(((1+a)*OP[i]) + (c*OP[i]*RP[i]))
    RP.append(((1+b)*RP[i]) + (d*OP[i]*RP[i]))

data = {'years': n, 'Oil': OP, 'Renewable Energy': RP}
```

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df = pd.DataFrame(data=data)
print(df)


#create array for n years
n = np.arange(31)
i = 0

#plot actual data and modeled data on the same graph to compare
ax = plt.gca()

ax.scatter(n, OP, color="b", label="Oil Production Amount")
ax.scatter(n, RP, color="r", label="Renewable Energy Production Amount")
plt.title("Production (Case 1)")
plt.xlabel("Year n since 2020")
plt.ylabel("Thousand Barrels/day")
plt.legend(loc="upper left")
ax.set_ylim([0, max(max(OP),max(RP))])
plt.show()
```

	years	Oil	Renewable Energy
0	0	5.964297e+06	2.120823e+06
1	1	6.277962e+06	2.007634e+06
2	2	6.636496e+06	1.890495e+06
3	3	7.046546e+06	1.769436e+06
4	4	7.515992e+06	1.644617e+06
5	5	8.054171e+06	1.516353e+06
6	6	8.672135e+06	1.385144e+06
7	7	9.382945e+06	1.251707e+06
8	8	1.020201e+07	1.117007e+06
9	9	1.114744e+07	9.822870e+05
10	10	1.224045e+07	8.490801e+05
11	11	1.350573e+07	7.192121e+05
12	12	1.497183e+07	5.947690e+05
13	13	1.667148e+07	4.780223e+05
14	14	1.864179e+07	3.713006e+05
15	15	2.092440e+07	2.767975e+05
16	16	2.356546e+07	1.963225e+05
17	17	2.661559e+07	1.310176e+05
18	18	3.012990e+07	8.109520e+04
19	19	3.416831e+07	4.567312e+04
20	20	3.879632e+07	2.279673e+04
21	21	4.408661e+07	9.704506e+03
22	22	5.012135e+07	3.316594e+03
23	23	5.699492e+07	8.159068e+02
24	24	6.481682e+07	1.117361e+02
25	25	7.371400e+07	1.434716e+00

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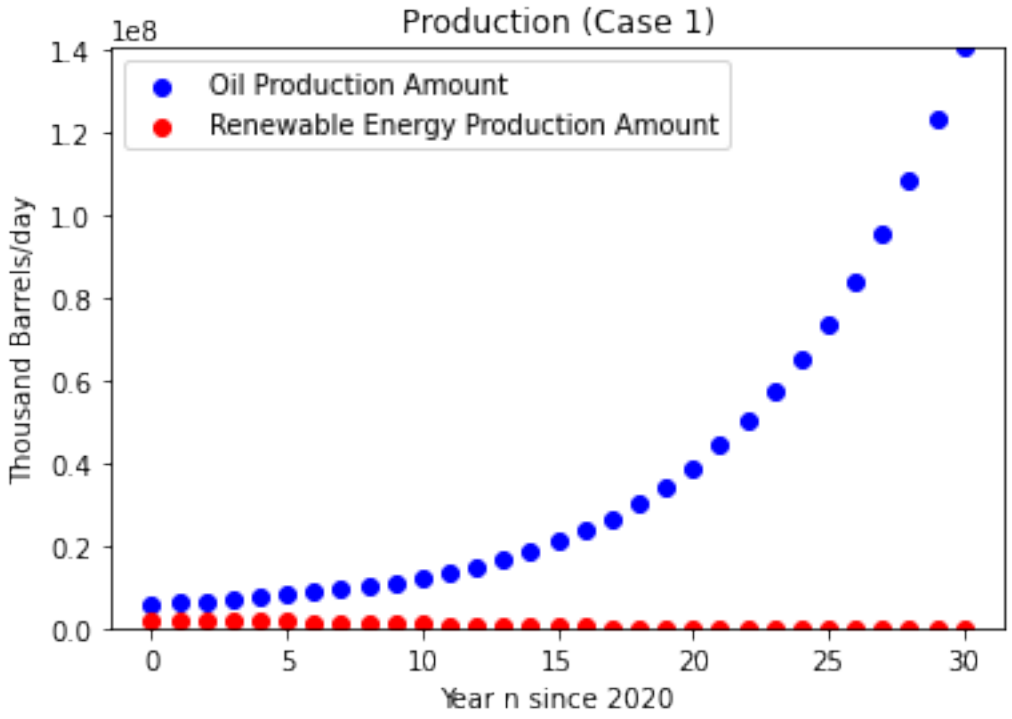
26      26  8.383280e+07     -1.841141e-01
27      27  9.534062e+07      5.318667e-02
28      28  1.084281e+08     -2.507586e-02
29      29  1.233122e+08      1.702959e-02
30      30  1.402394e+08     -1.558689e-02
```



[4]:
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#%%
# case 2: OP growth > RP growth & OP's i-factor > RP's i-factor

OP = [start_OP]
RP = [start_RP]
n = np.arange(31)
# growth factor of oil production
a = 0.15

# growth factor of renewable energy production
b = 0.05

# interaction factor of OP and RP
c = -0.000000015

# interaction factor of OP and RP
d = -0.000000040
```

```
for i in range(30):
    OP.append(((1+a)*OP[i]) + (c*OP[i]*RP[i]))
    RP.append(((1+b)*RP[i]) + (d*OP[i]*RP[i]))

data = {'years': n, 'Oil': OP, 'Renewable Energy': RP}
df = pd.DataFrame(data=data)
print(df)

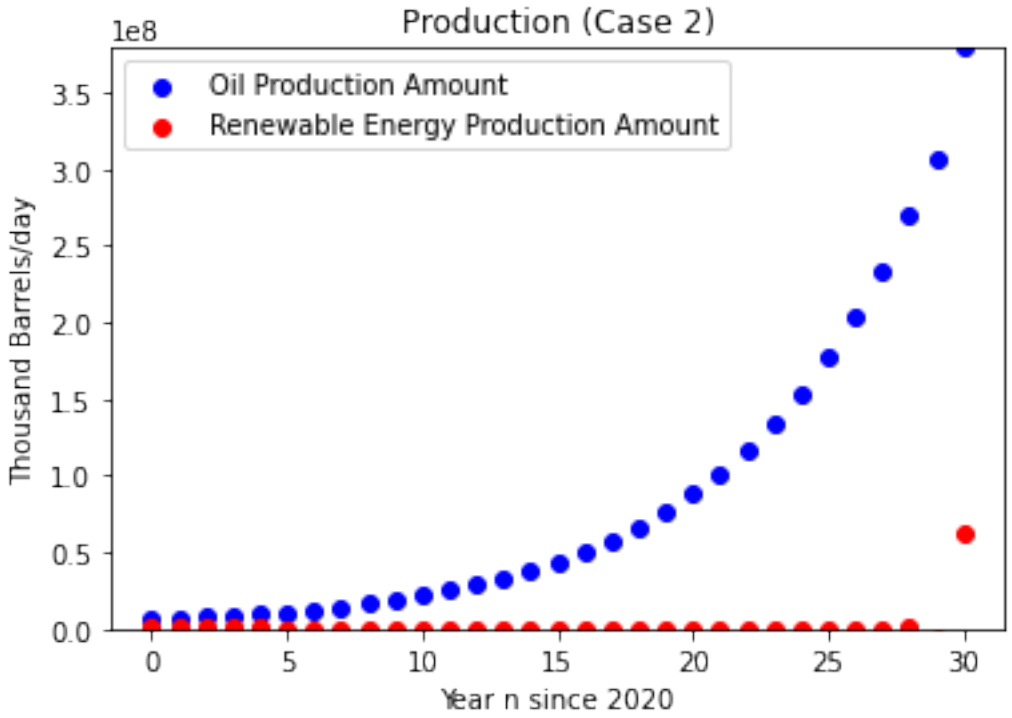

#create array for n years
n = np.arange(31)
i = 0

#plot actual data and modeled data on the same graph to compare
ax = plt.gca()

ax.scatter(n, OP, color="b", label="Oil Production Amount")
ax.scatter(n, RP, color="r", label="Renewable Energy Production Amount")
plt.title("Production (Case 2)")
plt.xlabel("Year n since 2020")
plt.ylabel("Thousand Barrels/day")
plt.legend(loc="upper left")
ax.set_ylim([0, max(max(OP),max(RP))])
plt.show()
```

```
    years           Oil  Renewable Energy
0       0  5.964297e+06      2.120823e+06
1       1  6.669203e+06      1.720896e+06
2       2  7.497429e+06      1.347860e+06
3       3  8.470461e+06      1.011034e+06
4       4  9.612571e+06      7.190286e+05
5       5  1.095078e+07      4.785115e+05
6       6  1.251480e+07      2.928341e+05
7       7  1.433705e+07      1.608854e+05
8       8  1.645300e+07      7.666483e+04
9       9  1.890203e+07      3.004341e+04
10     10  2.172882e+07      8.830319e+03
11     11  2.498526e+07      1.596939e+03
12     12  2.873245e+07      8.078825e+01
13     13  3.304229e+07     -8.022127e+00
14     14  3.799864e+07      2.179544e+00
15     15  4.369843e+07     -1.024267e+00
16     16  5.025319e+07      7.148739e-01
17     17  5.779117e+07     -6.863703e-01
18     18  6.645985e+07      8.659570e-01
19     19  7.642883e+07     -1.392800e+00
20     20  8.789315e+07      2.795563e+00
```

21	21	1.010771e+08	-6.893092e+00
22	22	1.162387e+08	2.063161e+01
23	23	1.336745e+08	-7.426447e+01
24	24	1.537258e+08	3.191129e+02
25	25	1.767839e+08	-1.627167e+03
26	26	2.033058e+08	9.797750e+03
27	27	2.337718e+08	-6.938995e+04
28	28	2.690809e+08	5.759971e+05
29	29	3.071182e+08	-5.594797e+06
30	30	3.789599e+08	6.285602e+07



[5]:
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#%%
# case 3: OP growth < RP growth & OP's i-factor < RP's i-factor

OP = [start_OP]
RP = [start_RP]
n = np.arange(31)
# growth factor of oil production
a = 0.05

# growth factor of renewable energy production
b = 0.15

# interaction factor of OP and RP
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```
c = -0.000000040

# interaction factor of OP and RP
d = -0.000000015

for i in range(30):
    OP.append(((1+a)*OP[i]) + (c*OP[i]*RP[i]))
    RP.append(((1+b)*RP[i]) + (d*OP[i]*RP[i]))

data = {'years': n, 'Oil': OP, 'Renewable Energy': RP}
df = pd.DataFrame(data=data)
print(df)

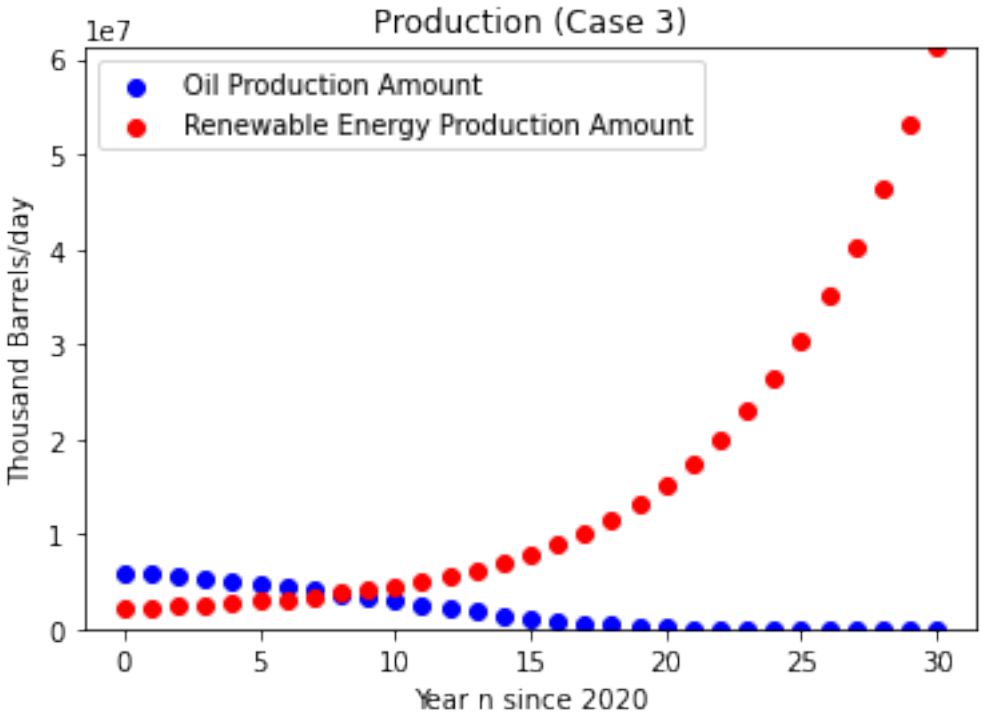

#create array for n years
n = np.arange(31)
i = 0

#plot actual data and modeled data on the same graph to compare
ax = plt.gca()

ax.scatter(n, OP, color="b", label="Oil Production Amount")
ax.scatter(n, RP, color="r", label="Renewable Energy Production Amount")
plt.title("Production (Case 3)")
plt.xlabel("Year n since 2020")
plt.ylabel("Thousand Barrels/day")
plt.legend(loc="upper left")
ax.set_ylim([0, max(max(OP),max(RP))])
plt.show()
```

```
    years           Oil  Renewable Energy
0       0  5.964297e+06      2.120823e+06
1       1  5.756543e+06      2.249208e+06
2       2  5.526464e+06      2.392375e+06
3       3  5.273932e+06      2.552910e+06
4       4  4.999074e+06      2.733889e+06
5       5  4.702351e+06      2.938968e+06
6       6  4.384666e+06      3.172513e+06
7       7  4.047483e+06      3.439733e+06
8       8  3.692967e+06      3.746860e+06
9       9  3.324134e+06      4.101333e+06
10     10  2.945005e+06      4.512032e+06
11     11  2.560737e+06      4.989518e+06
12     12  2.177700e+06      5.546293e+06
13     13  1.803459e+06      6.197064e+06
14     14  1.446586e+06      6.958982e+06
15     15  1.116244e+06      7.851827e+06
```

```
16      16  8.214743e+05      8.898133e+06
17      17  5.701645e+05      1.012321e+07
18      18  3.677970e+05      1.155511e+07
19      19  2.161894e+05      1.322463e+07
20      20  1.126379e+05      1.516544e+07
21      21  4.994166e+04      1.741463e+07
22      22  1.765012e+04      2.001378e+07
23      23  4.402800e+03      2.301055e+07
24      24  5.705060e+02      2.646061e+07
25      25 -4.806225e+00      3.042948e+07
26      26  8.035004e-01      3.499390e+07
27      27 -2.810291e-01      4.024299e+07
28      28  1.572975e-01      4.627943e+07
29      29 -1.260232e-01      5.322135e+07
30      30  1.359606e-01      6.120455e+07
```



[6]:
```
#%%
# case 4: OP growth < RP growth & OP's i-factor > RP's i-factor

OP = [start_OP]
RP = [start_RP]
n = np.arange(31)
# growth factor of oil production
a = 0.05
```

```
# growth factor of renewable energy production
b = 0.15

# interaction factor of OP and RP
c = -0.000000015

# interaction factor of OP and RP
d = -0.000000040

for i in range(30):
    OP.append(((1+a)*OP[i]) + (c*OP[i]*RP[i]))
    RP.append(((1+b)*RP[i]) + (d*OP[i]*RP[i]))

data = {'years': n, 'Oil': OP, 'Renewable Energy': RP}
df = pd.DataFrame(data=data)
print(df)

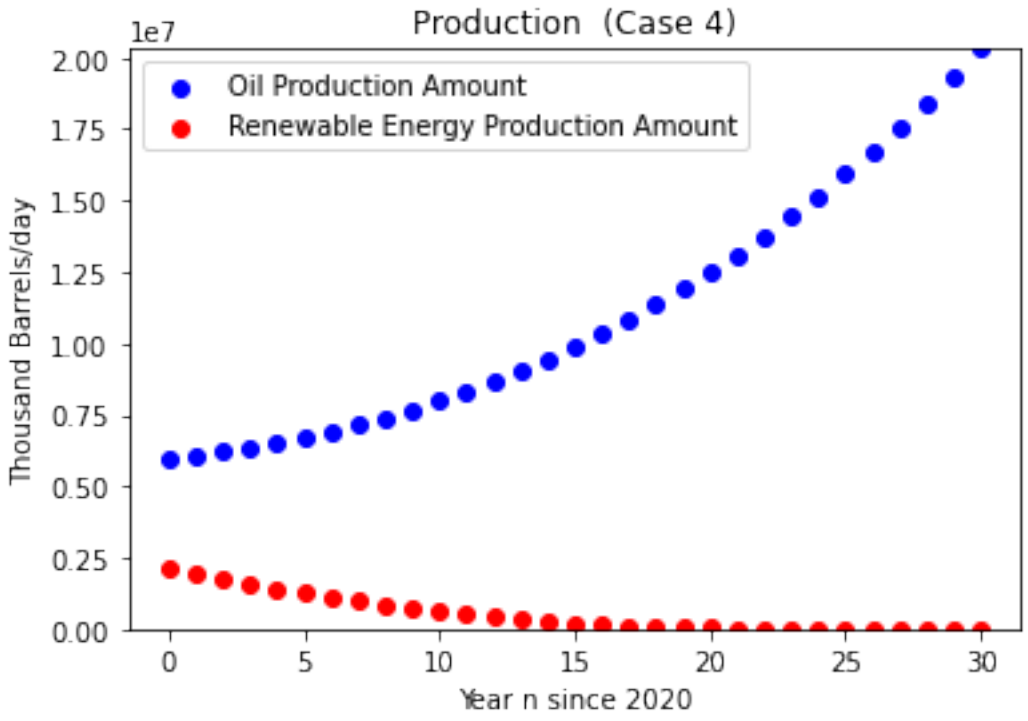

#create array for n years
n = np.arange(31)
i = 0

#plot actual data and modeled data on the same graph to compare
ax = plt.gca()

ax.scatter(n, OP, color="b", label="Oil Production Amount")
ax.scatter(n, RP, color="r", label="Renewable Energy Production Amount")
plt.title("Production  (Case 4)")
plt.xlabel("Year n since 2020")
plt.ylabel("Thousand Barrels/day")
plt.legend(loc="upper left")
ax.set_ylim([0, max(max(OP),max(RP))])
plt.show()
```

```
    years           Oil  Renewable Energy
0       0  5.964297e+06      2.120823e+06
1       1  6.072774e+06      1.932978e+06
2       2  6.200334e+06      1.753383e+06
3       3  6.347277e+06      1.581528e+06
4       4  6.514065e+06      1.417221e+06
5       5  6.701291e+06      1.260530e+06
6       6  6.909647e+06      1.111722e+06
7       7  7.139906e+06      9.712161e+05
8       8  7.392885e+06      8.395229e+05
9       9  7.669432e+06      7.171915e+05
10     10  7.970397e+06      6.047521e+05
```

11	11	8.296615e+06	5.026604e+05
12	12	8.648890e+06	4.112443e+05
13	13	9.027982e+06	3.306586e+05
14	14	9.434604e+06	2.608502e+05
15	15	9.869419e+06	2.015370e+05
16	16	1.033305e+07	1.522054e+05
17	17	1.082612e+07	1.121264e+05
18	18	1.134921e+07	8.038961e+04
19	19	1.190299e+07	5.595370e+04
20	20	1.248815e+07	3.770611e+04
21	21	1.310549e+07	2.452685e+04
22	22	1.375594e+07	1.534842e+04
23	23	1.444057e+07	9.205402e+03
24	24	1.516061e+07	5.268960e+03
25	25	1.591744e+07	2.864079e+03
26	26	1.671263e+07	1.470138e+03
27	27	1.754789e+07	7.078639e+02
28	28	1.842510e+07	3.171827e+02
29	29	1.934627e+07	1.309952e+02
30	30	2.031354e+07	4.927374e+01



[7]:
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#%%
# case 5: OP growth < RP growth & OP's i-factor > RP's i-factor
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```
OP = [start_OP]
RP = [start_RP]
n = np.arange(31)
# growth factor of oil production
a = 0.05

# growth factor of renewable energy production
b = 0.05

# interaction factor of OP and RP
c = -0.000000030

# interaction factor of OP and RP
d = -0.000000030

for i in range(30):
    OP.append(((1+a)*OP[i]) + (c*OP[i]*RP[i]))
    RP.append(((1+b)*RP[i]) + (d*OP[i]*RP[i]))

data = {'years': n, 'Oil': OP, 'Renewable Energy': RP}
df = pd.DataFrame(data=data)
print(df)

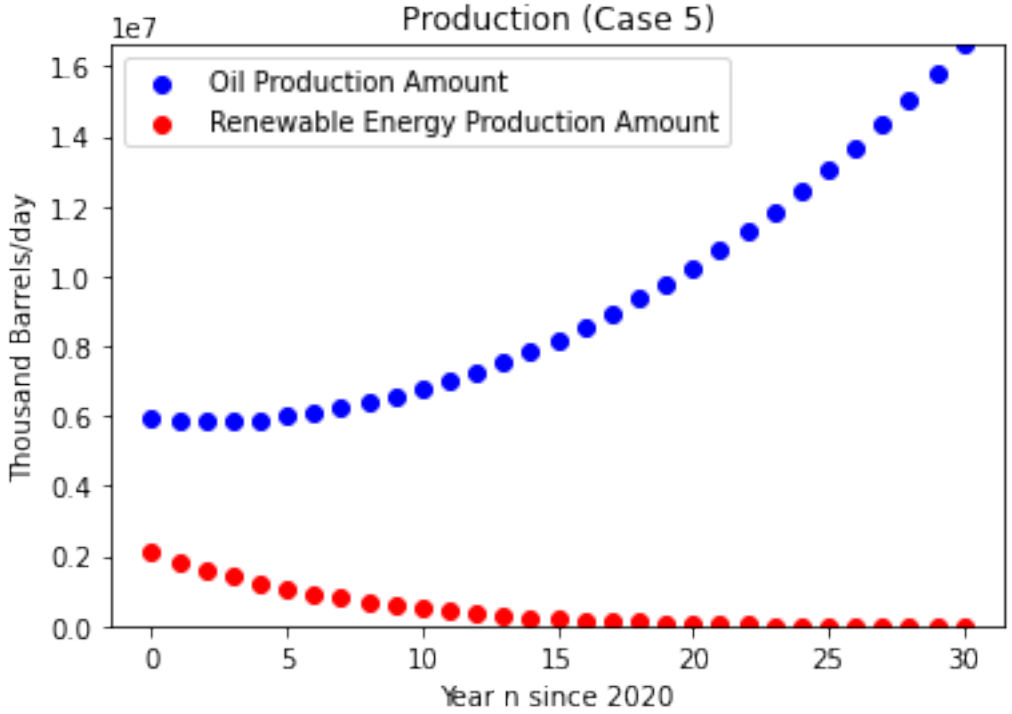

#create array for n years
n = np.arange(31)
i = 0

#plot actual data and modeled data on the same graph to compare
ax = plt.gca()

ax.scatter(n, OP, color="b", label="Oil Production Amount")
ax.scatter(n, RP, color="r", label="Renewable Energy Production Amount")
plt.title("Production (Case 5)")
plt.xlabel("Year n since 2020")
plt.ylabel("Thousand Barrels/day")
plt.legend(loc="upper left")
ax.set_ylim([0, max(max(OP),max(RP))])
plt.show()
```

```
    years           Oil  Renewable Energy
0       0  5.964297e+06      2.120823e+06
1       1  5.883035e+06      1.847388e+06
2       2  5.851140e+06      1.613710e+06
3       3  5.860435e+06      1.411134e+06
4       4  5.905361e+06      1.233595e+06
5       5  5.982085e+06      1.076730e+06
```

6	6	6.087956e+06	9.373337e+05
7	7	6.221161e+06	8.130070e+05
8	8	6.380483e+06	7.019220e+05
9	9	6.565149e+06	6.026600e+05
10	10	6.774710e+06	5.140964e+05
11	11	7.008960e+06	4.353156e+05
12	12	7.267875e+06	3.655481e+05
13	13	7.551566e+06	3.041228e+05
14	14	7.860246e+06	2.504308e+05
15	15	8.194205e+06	2.038989e+05
16	16	8.553792e+06	1.639702e+05
17	17	8.939404e+06	1.300917e+05
18	18	9.351486e+06	1.017080e+05
19	19	9.790527e+06	7.825978e+04
20	20	1.025707e+07	5.918663e+04
21	21	1.075171e+07	4.393353e+04
22	22	1.127512e+07	3.195939e+04
23	23	1.182807e+07	2.274698e+04
24	24	1.241140e+07	1.581274e+04
25	25	1.302608e+07	1.071563e+04
26	26	1.367320e+07	7.063932e+03
27	27	1.435396e+07	4.519532e+03
28	28	1.506971e+07	2.799313e+03
29	29	1.582193e+07	1.673733e+03
30	30	1.661224e+07	9.629692e+02



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