In [45]:
```
import os
import pandas as pd
import matplotlib.pyplot as plt
from scipy import stats
from statsmodels.tsa.seasonal import seasonal_decompose
import matplotlib.dates as mdates
```

Analisis Exploratorio Consumo

In [9]:
```
df = pd.read_csv('data/consumo.csv', parse_dates=['Fecha'])
df
```

Out[9]:

	Fecha	Aceites lubricantes	Asfalto	Bunker	Ceras	Combustible turbo jet	Diesel bajo azufre	Diesel ultra bajo azufre
0	2000-01-01	0.00	48446.00	296766.99	0.00	0.00	0.00	0.00
1	2000-02-01	0.00	50597.00	328116.44	0.00	0.00	0.00	0.00
2	2000-03-01	0.00	27593.00	368589.63	0.00	0.00	0.00	0.00
3	2000-04-01	0.00	53794.00	396300.47	0.00	0.00	0.00	0.00
4	2000-05-01	0.00	60137.00	449368.92	0.00	0.00	0.00	0.00
...	...	...	...	...	...	...	...	...
295	2024-08-01	32669.87	16086.77	155156.95	-129.83	88992.17	1220254.20	13769.72
296	2024-09-01	17724.39	14404.37	129059.65	-682.98	78639.27	1161480.31	14234.41
297	2024-10-01	2900.53	14718.66	168233.85	18.55	77767.06	1399433.57	15236.22
298	2024-11-01	26601.36	40510.01	126219.84	42.69	82355.21	1307939.01	24281.06
299	2024-12-01	32294.67	32072.23	138019.95	-105.04	52651.66	1474651.06	24615.04

300 rows × 24 columns

Combinar variantes de diesel en una sola columna “Diesel”

In [11]:
```
diesel_cols = ['Diesel alto azufre', 'Diesel bajo azufre', 'Diesel ultra bajo azufr
df['Diesel'] = df[diesel_cols].sum(axis=1)
```

Seleccionar sólo Fecha y las tres variables de interés

In [13]:
```
cols = ['Gasolina regular', 'Gasolina superior', 'Diesel']
df = df[['Fecha'] + cols].dropna()
```

Estadísticas descriptivas

In [14]:
```
print("=== Estadísticas descriptivas ===")
print(df[cols].describe())
```

```
=== Estadísticas descriptivas ===
       Gasolina regular  Gasolina superior        Diesel
count        300.000000         300.000000  3.000000e+02
mean      397478.894458      470248.678849  8.821302e+05
std       219102.049432      113504.653305  2.291115e+05
min       160741.900000      300242.781667  5.076627e+05
25%       215650.312917      383931.904375  6.997895e+05
50%       288193.130000      423319.540000  8.110382e+05
75%       548073.682500      573704.195000  1.053747e+06
max       938086.570000      786598.120000  1.499266e+06
```

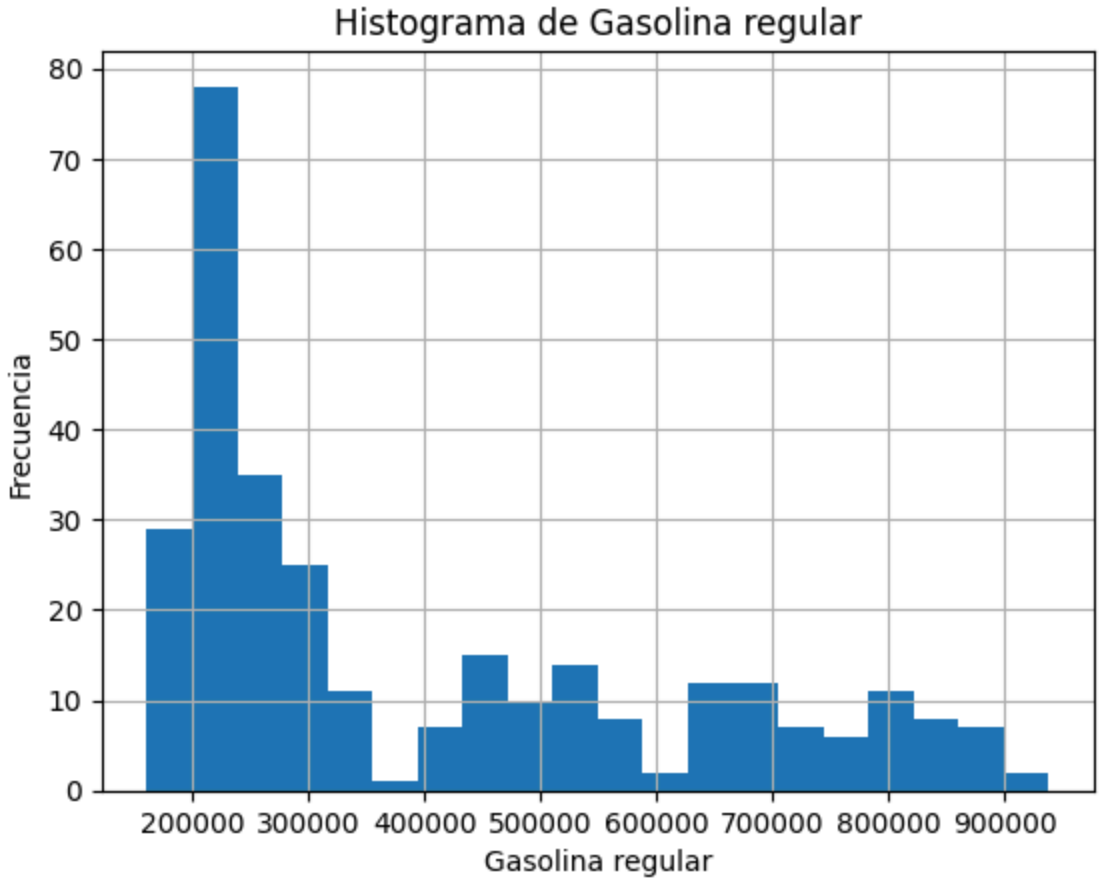
Test “discreto” vs “continuo” por conteo de únicos

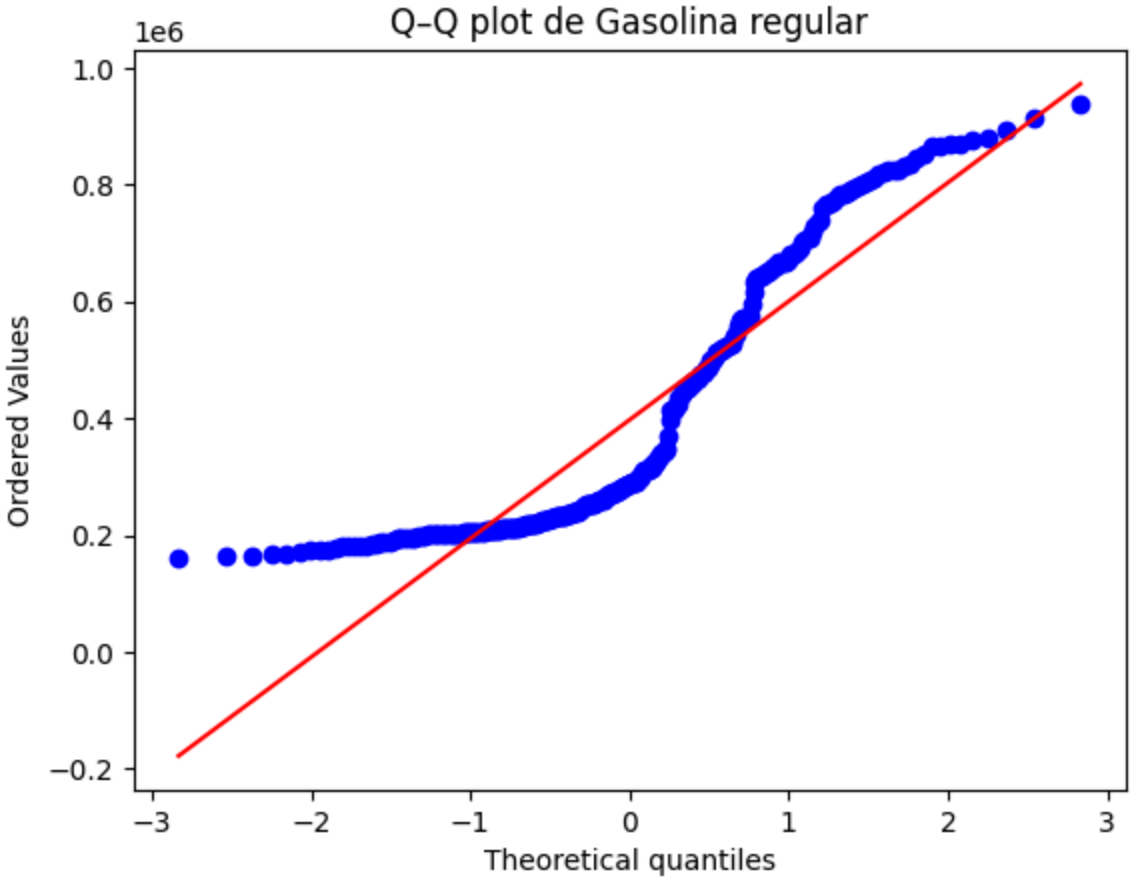
In [23]:
```
for c in cols:
    total = len(df)
    unicos = df[c].nunique()
    ratio = unicos / total
    pct = ratio * 100

    print(f"{c}: dtype={df[c].dtype}")
    print(f"  únicos: {unicos} de {total} ({pct:.2f}%)")

    if ratio > 0.05:
        print("  ⇒ parece CONTINUA (muchos valores únicos)\n")
    else:
        print("  ⇒ podría ser DISCRETA (pocos valores únicos)\n")
```

```
Gasolina regular: dtype=float64
  únicos: 300 de 300 (100.00%)
  ⇒ parece CONTINUA (muchos valores únicos)

Gasolina superior: dtype=float64
  únicos: 300 de 300 (100.00%)
  ⇒ parece CONTINUA (muchos valores únicos)

Diesel: dtype=float64
  únicos: 300 de 300 (100.00%)
  ⇒ parece CONTINUA (muchos valores únicos)
```

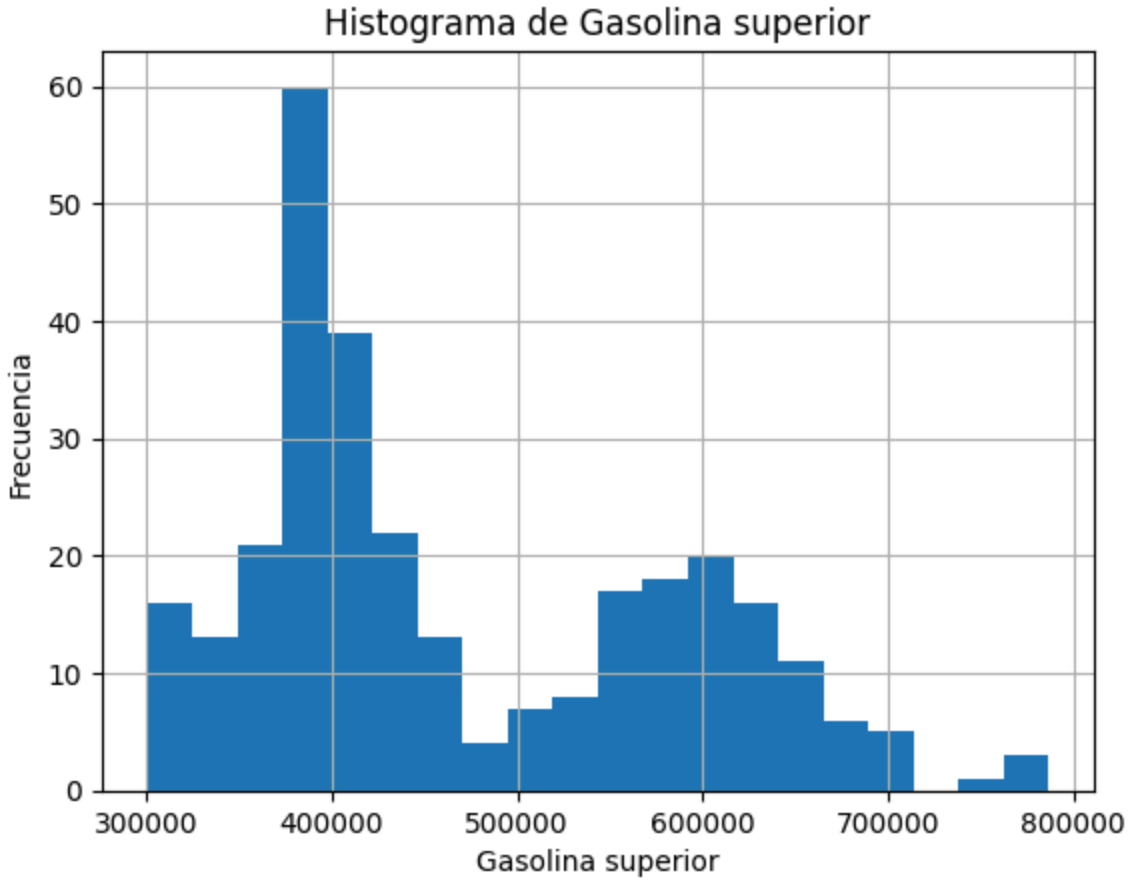
Histogramas, Q–Q plots y test de normalidad (Shapiro–Wilk)

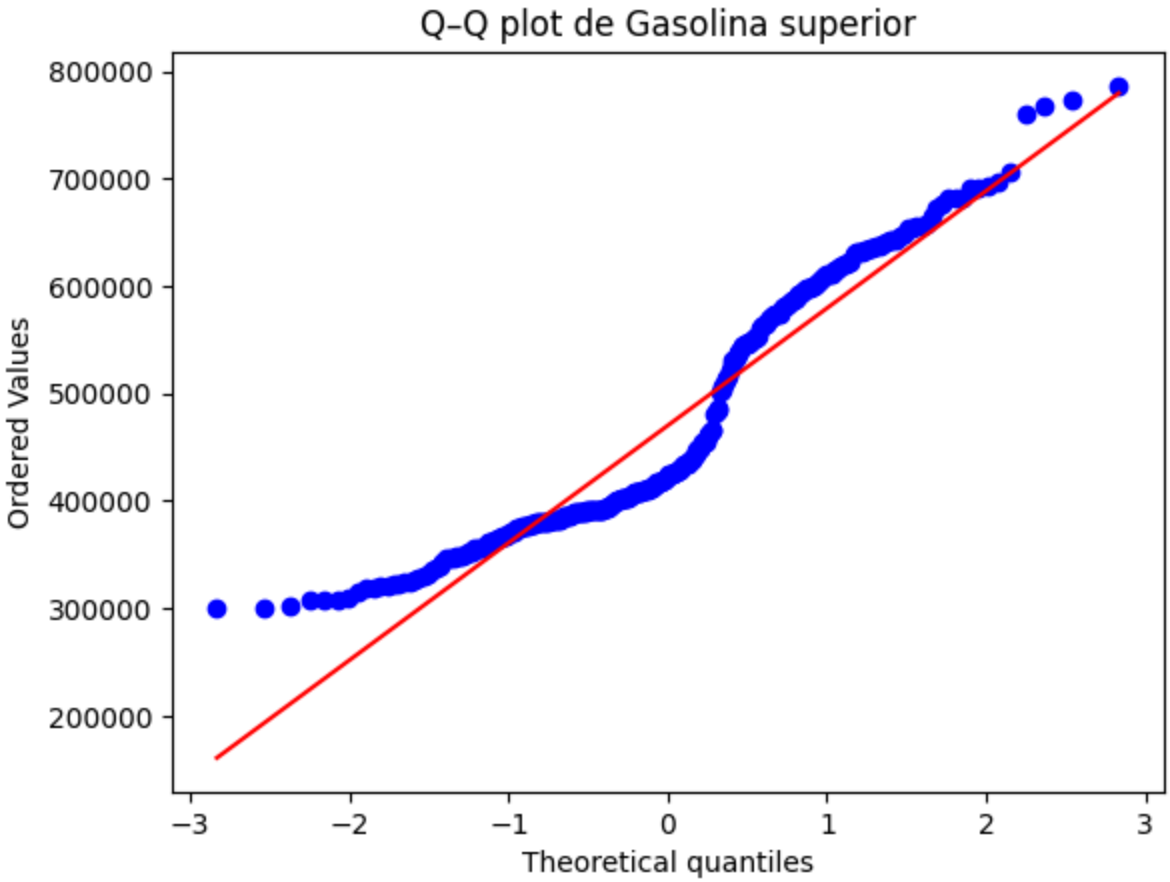
In [15]:
```python
for c in cols:
    plt.figure()
    df[c].hist(bins=20)
    plt.title(f'Histograma de {c}')
    plt.xlabel(c); plt.ylabel('Frecuencia')
    plt.show()

    plt.figure()
    stats.probplot(df[c], dist="norm", plot=plt)
    plt.title(f'Q-Q plot de {c}')
    plt.show()

    W, p = stats.shapiro(df[c])
    print(f"Shapiro-Wilk para {c}: W={W:.4f}, p-value={p:.4f}\n")
```



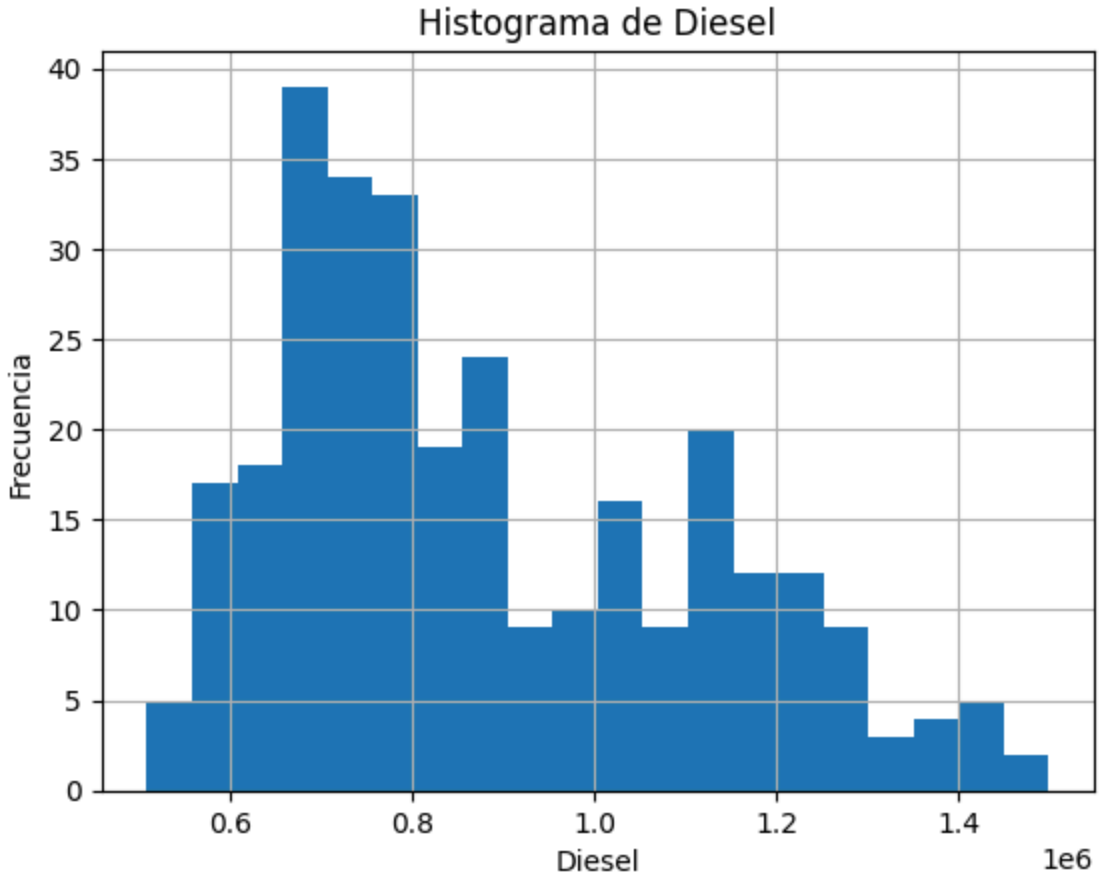


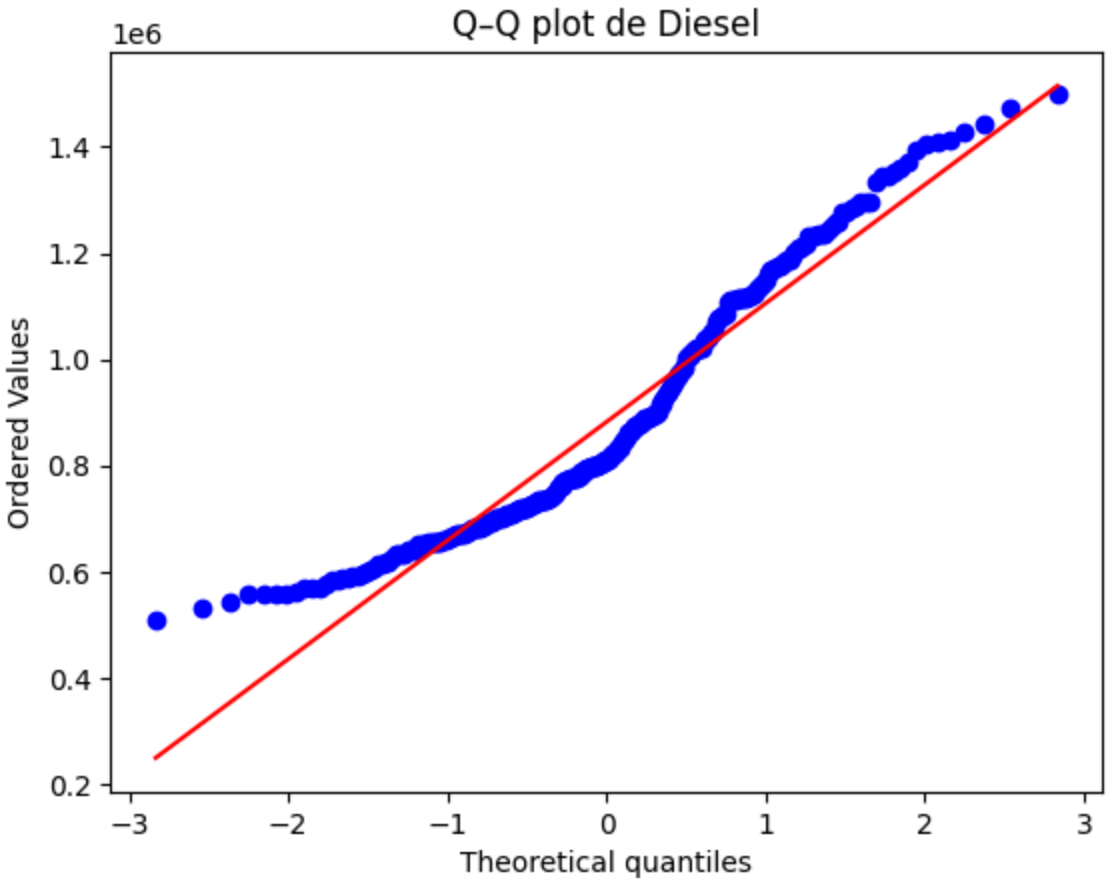

```
Shapiro-Wilk para Gasolina regular: W=0.8452, p-value=0.0000
```






```
Shapiro–Wilk para Gasolina superior: W=0.9129, p-value=0.0000
```





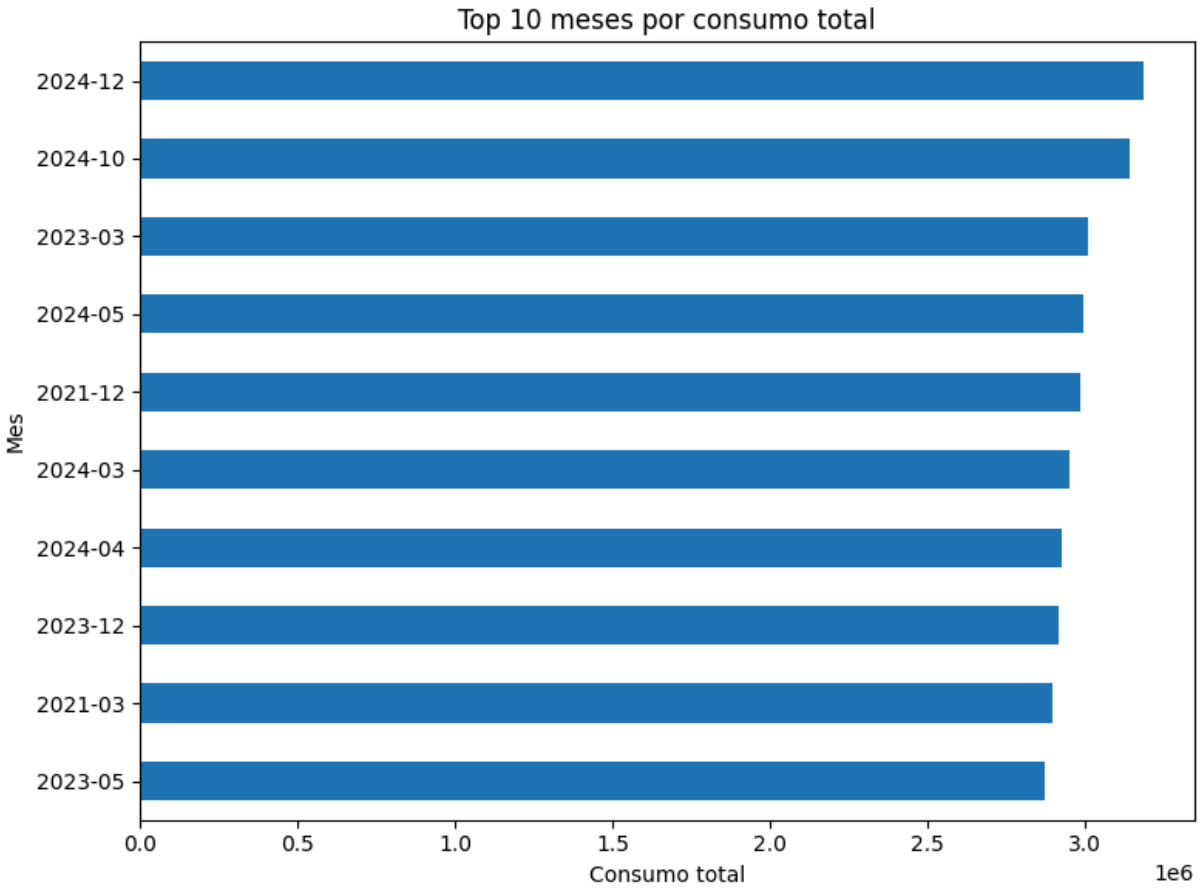

```
Shapiro–Wilk para Diesel: W=0.9370, p-value=0.0000
```

Agregar columnas de año y mes

In [17]:
```
df['Año'] = df['Fecha'].dt.year
df['Mes'] = df['Fecha'].dt.to_period('M')
```

Top 10 meses con mayor consumo total

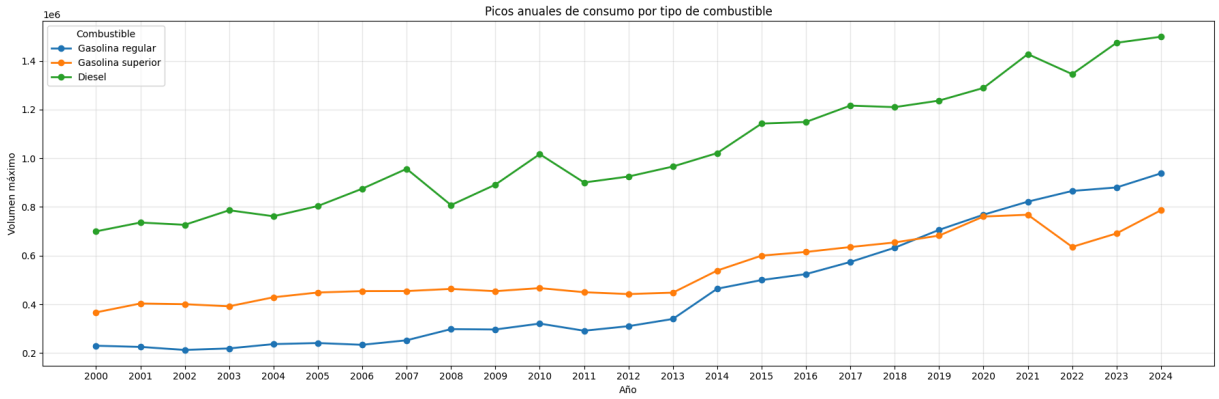
In [24]:
```
df['Total'] = df[cols].sum(axis=1)
top_meses = df.groupby('Mes')['Total'].sum().nlargest(10)
plt.figure(figsize=(8,6))
top_meses.sort_values().plot(kind='barh')
plt.title('Top 10 meses por consumo total')
plt.xlabel('Consumo total')
plt.ylabel('Mes')
plt.tight_layout()
plt.show()
```



Picos anuales por tipo de combustible

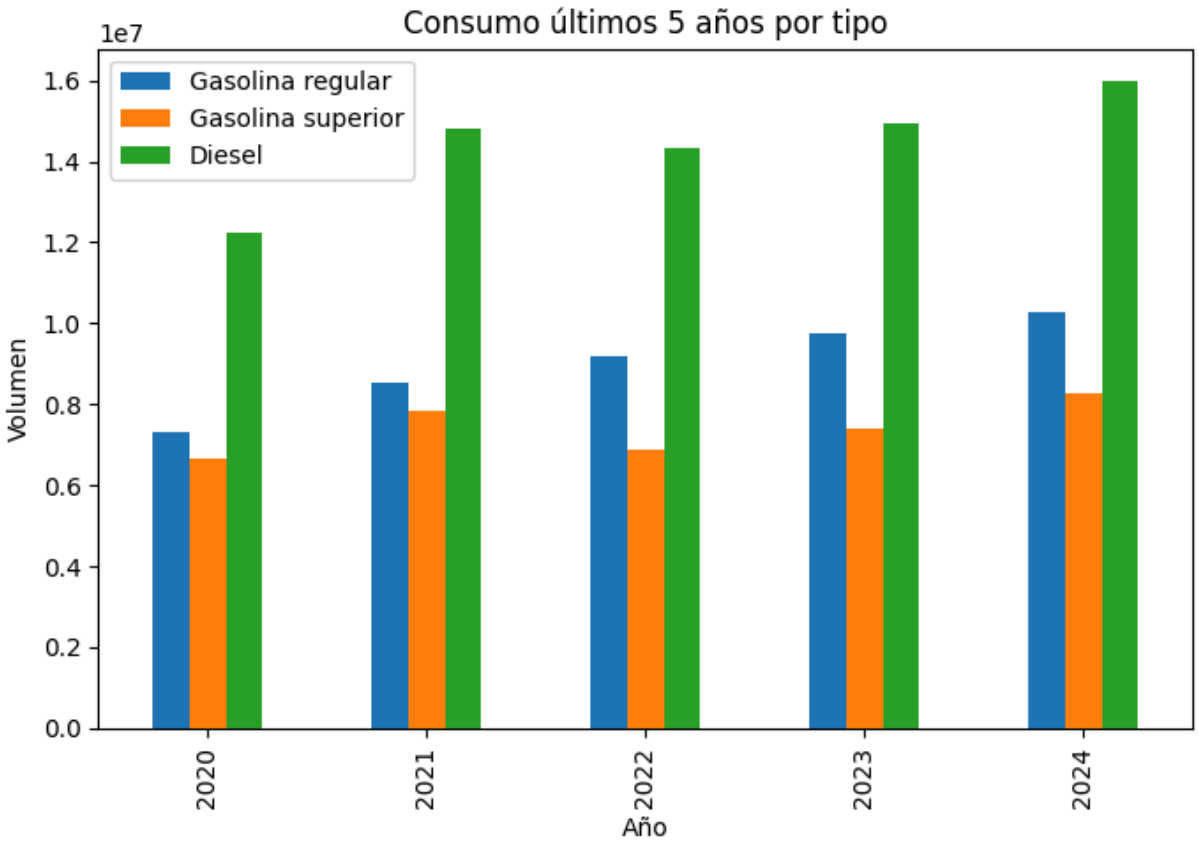
In [29]:
```
picos_anuales = df.groupby('Año')[cols].max()
años = picos_anuales.index.astype(int)

plt.figure(figsize=(18,6))
```

```
for c in cols:
    plt.plot(años, picos_anuales[c], marker='o', linewidth=2, label=c)

plt.title('Picos anuales de consumo por tipo de combustible')
plt.xlabel('Año')
plt.ylabel('Volumen máximo')
plt.xticks(años)
plt.legend(title='Combustible')
plt.grid(alpha=0.3)
plt.tight_layout()
plt.show()
```



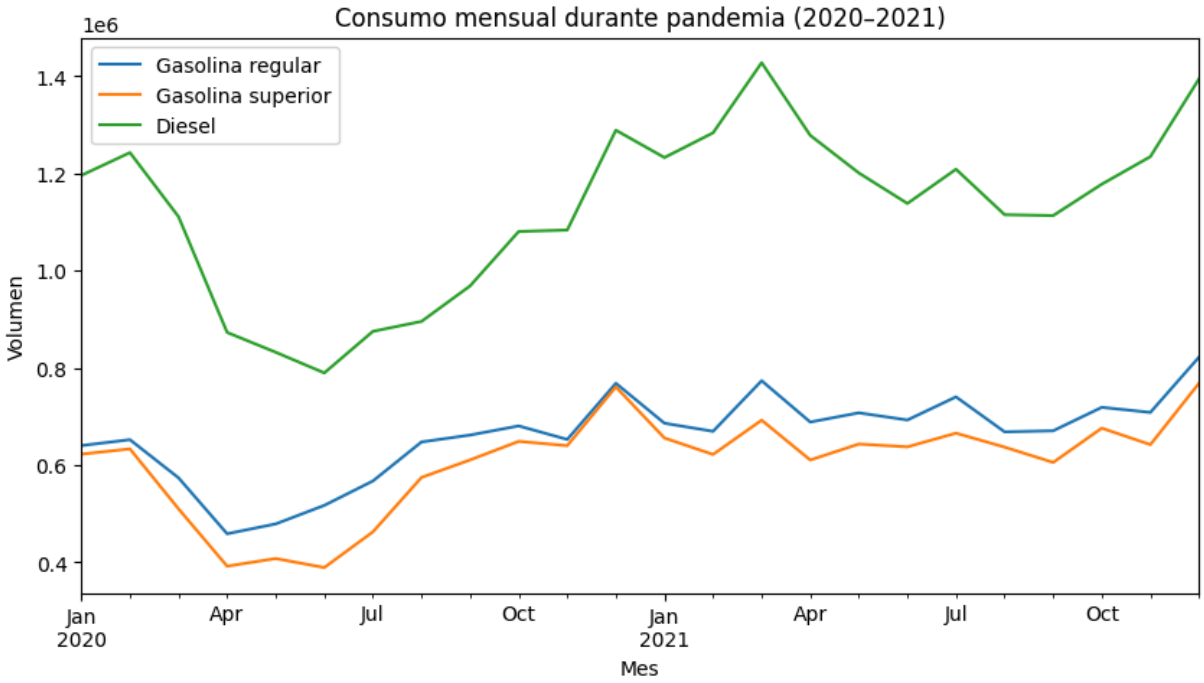
Evolución en los últimos 5 años

In [20]:
```
ultimo = df['Año'].max()
ult5 = df[df['Año'] >= ultimo - 4]
suma_ult5 = ult5.groupby('Año')[cols].sum()
suma_ult5.plot(kind='bar', figsize=(8,5))
plt.title('Consumo últimos 5 años por tipo')
plt.ylabel('Volumen')
plt.show()
```



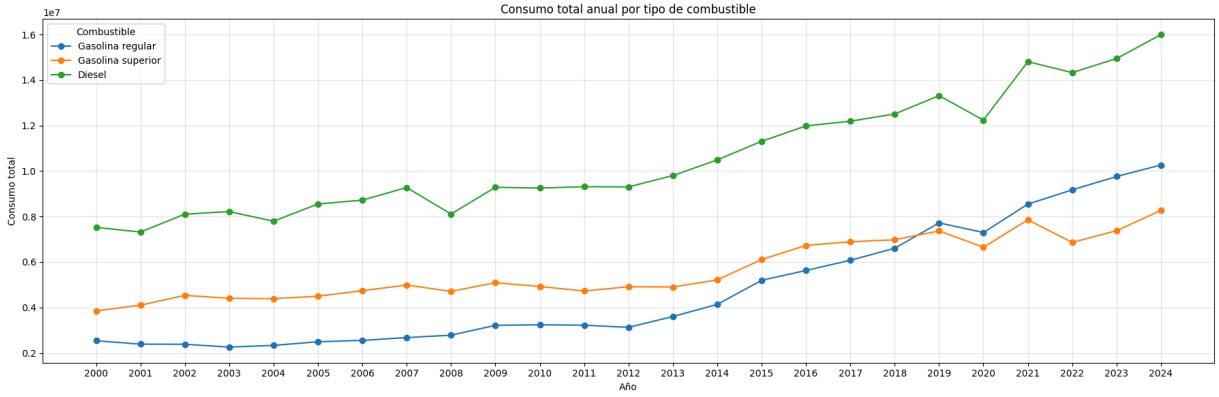
Comportamiento durante la pandemia (2020–2021)

In [21]:
```
pandemia = df[df['Año'].isin([2020, 2021])]
mensual_pandemia = pandemia.groupby('Mes')[cols].sum()
mensual_pandemia.plot(figsize=(10,5))
plt.title('Consumo mensual durante pandemia (2020-2021)')
plt.ylabel('Volumen')
plt.show()
```



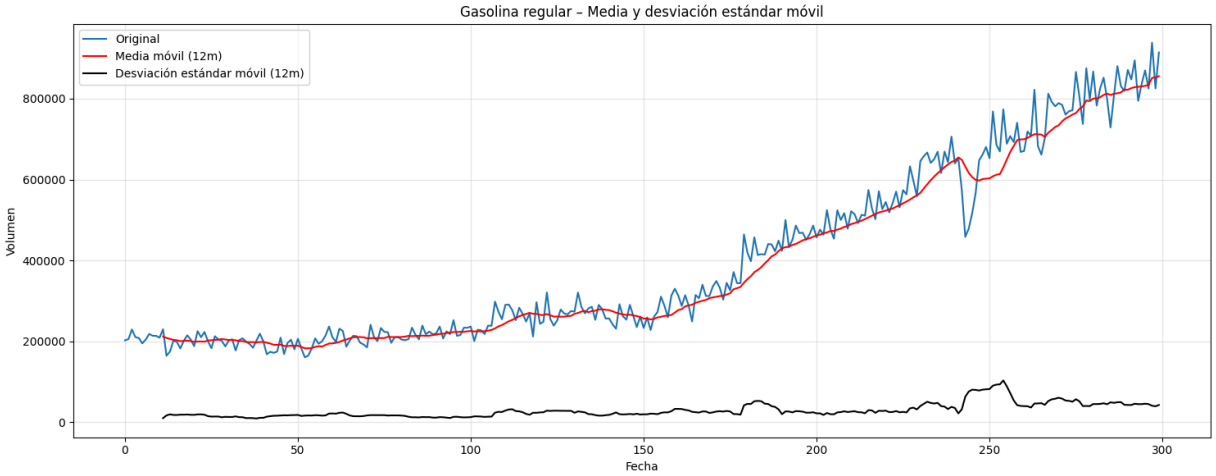
Consumo total de los combustibles por años

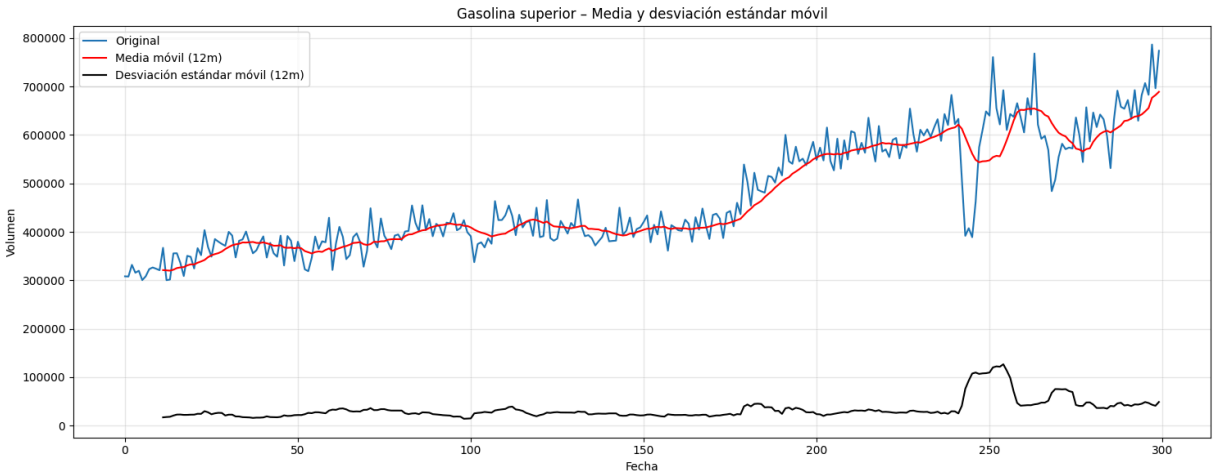
In [32]:
```
yearly = df.groupby('Año')[cols].sum()

plt.figure(figsize=(18,6))
for c in cols:
    plt.plot(yearly.index, yearly[c], marker='o', label=c)

plt.title('Consumo total anual por tipo de combustible')
plt.xlabel('Año')
plt.ylabel('Consumo total')
plt.xticks(yearly.index)
plt.legend(title='Combustible')
plt.grid(alpha=0.3)
plt.tight_layout()
plt.show()
```

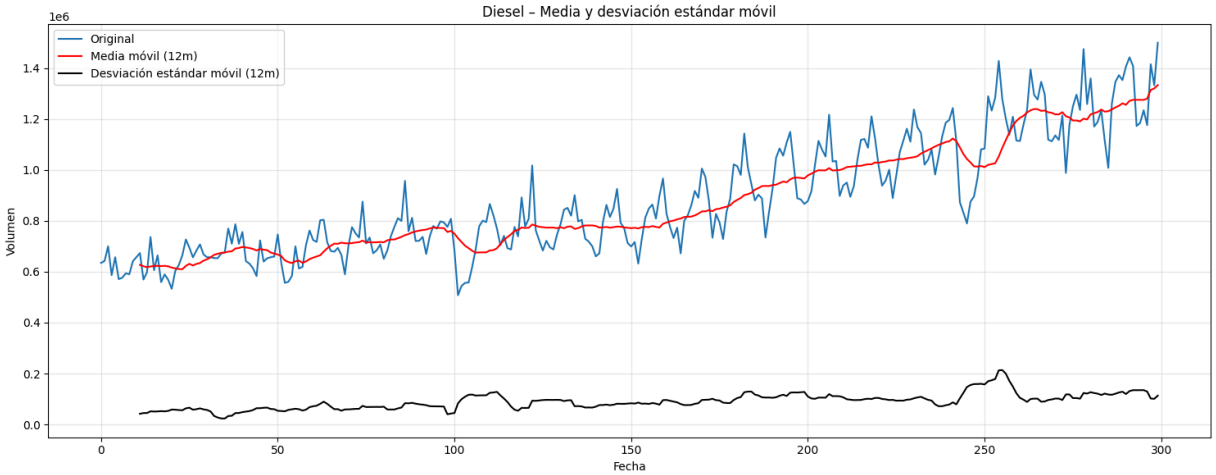


Media y desviacion estandar

In [37]:
```
cols = ['Gasolina regular', 'Gasolina superior', 'Diesel']
window = 12  # meses

# Generar un gráfico por cada tipo de combustible
for c in cols:
    ts = df[c].dropna()
    roll_mean = ts.rolling(window).mean()
    roll_std  = ts.rolling(window).std()

    plt.figure(figsize=(15,6))
    plt.plot(ts.index, ts, label='Original')
    plt.plot(roll_mean.index, roll_mean, color='red', label=f'Media móvil ({window}
    plt.plot(roll_std.index, roll_std, color='black', label=f'Desviación estándar m
    plt.title(f'{c} – Media y desviación estándar móvil')
    plt.xlabel('Fecha')
    plt.ylabel('Volumen')
    plt.legend()
    plt.grid(alpha=0.3)
    plt.tight_layout()
    plt.show()
```

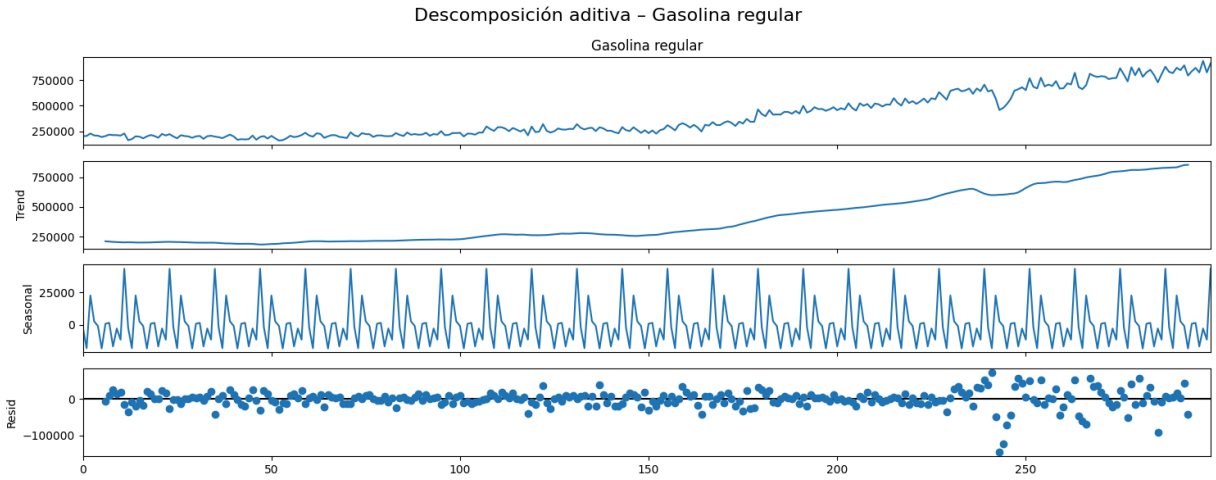


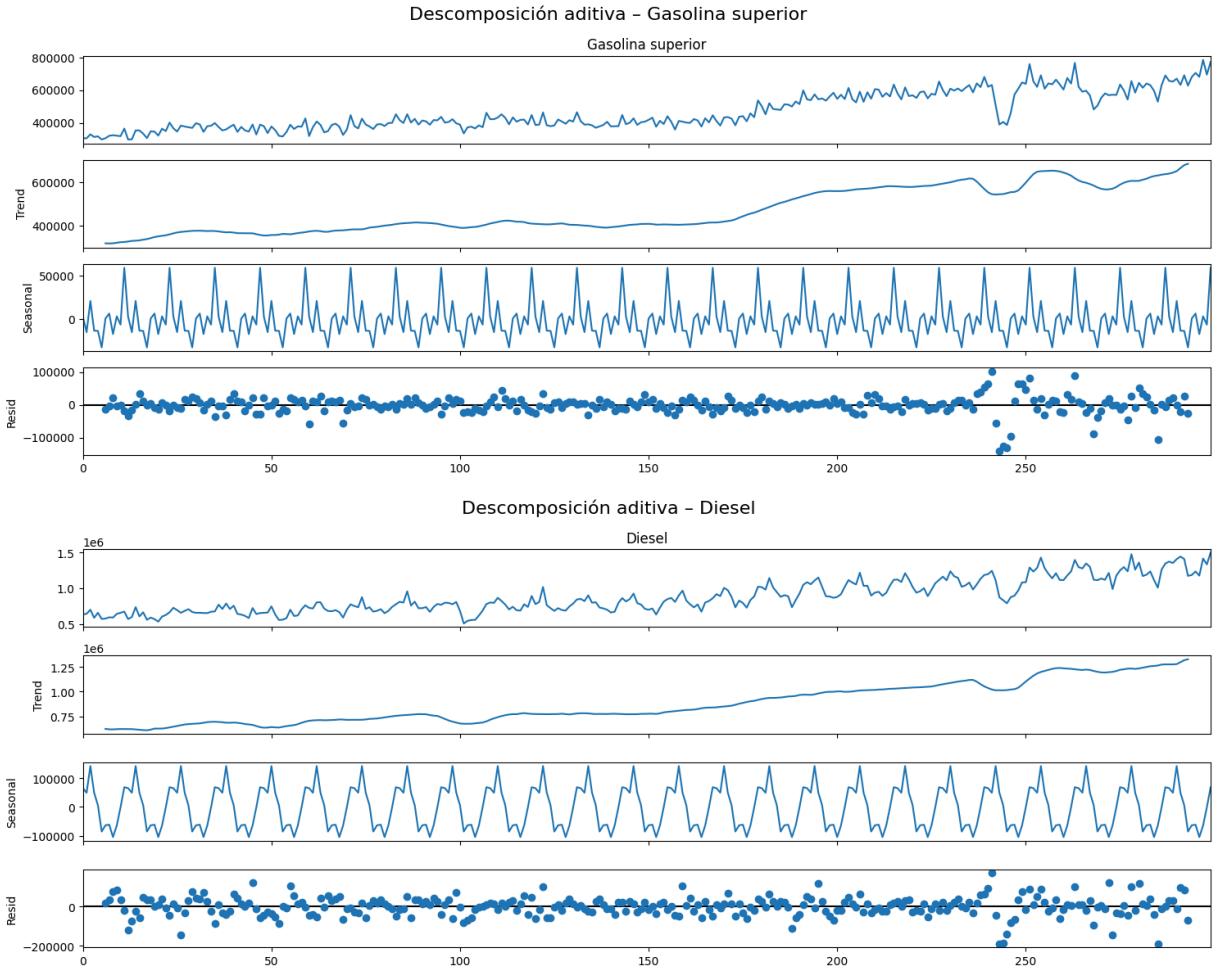




DESCOMPOSICION ADITIVA

In [ ]:
```
for c in cols:
    ts = df[c].dropna()
    result = seasonal_decompose(ts, model='additive', period=window)

    fig = result.plot()
    fig.set_size_inches(15, 6)

    fig.suptitle(f'Descomposición aditiva – {c}', fontsize=16)
    plt.tight_layout()
    plt.show()
```





Analisis exploratorio importacion

In [50]:
```
df = pd.read_csv('./data/importacion.csv', parse_dates=['Fecha'], dayfirst=True)
```

Unificar variacion de diesel y fechas

In [51]:
```
diesel_cols = ['Diesel alto azufre', 'Diesel bajo azufre', 'Diesel ultra bajo azufr
df['Diesel'] = df[diesel_cols].sum(axis=1)
```

In [52]:
```
cols = ['Gasolina regular', 'Gasolina superior', 'Diesel']
df = df[['Fecha'] + cols].dropna()
```

Estadísticas descriptivas

In [53]:
```
print("=== Estadísticas descriptivas ===")
print(df[cols].describe())
```

```
=== Estadísticas descriptivas ===
       Gasolina regular  Gasolina superior        Diesel
count      2.880000e+02       2.880000e+02  2.880000e+02
mean       4.129493e+05       4.909544e+05  8.950957e+05
std        2.432627e+05       1.565581e+05  2.939973e+05
min        8.101530e+04       1.702925e+05  2.297647e+05
25%        2.082069e+05       3.693299e+05  6.920462e+05
50%        3.275593e+05       4.813002e+05  8.462861e+05
75%        5.761171e+05       6.083053e+05  1.124961e+06
max        1.141366e+06       1.227174e+06  1.630636e+06
```

Test “discreto” vs “continuo” por conteo de únicos

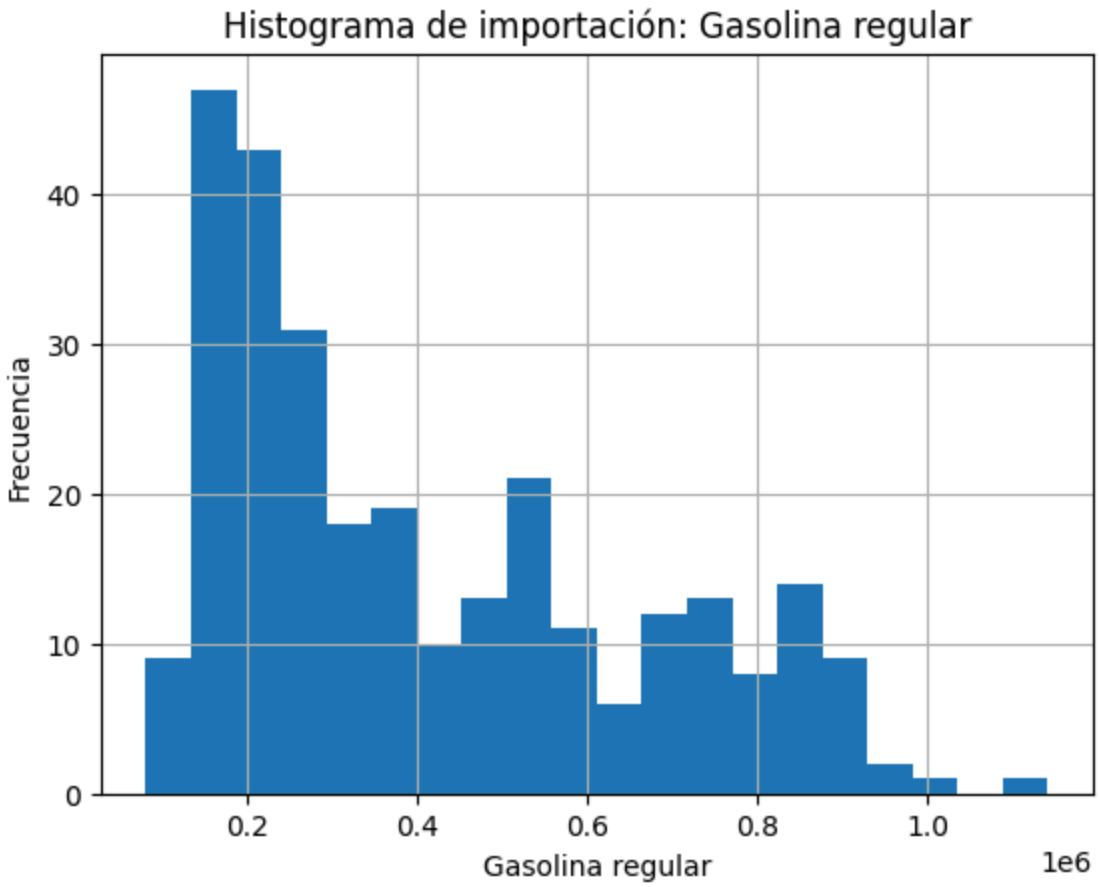
In [68]:
```
for c in cols:
    total = len(df)
    unicos = df[c].nunique()
    ratio = unicos / total
    pct = ratio * 100

    print(f"{c}: dtype={df[c].dtype}")
    print(f"  únicos: {unicos} de {total} ({pct:.2f}%)")

    if ratio > 0.05:
        print("  ⇒ parece CONTINUA (muchos valores únicos)\n")
    else:
        print("  ⇒ podría ser DISCRETA (pocos valores únicos)\n")
```

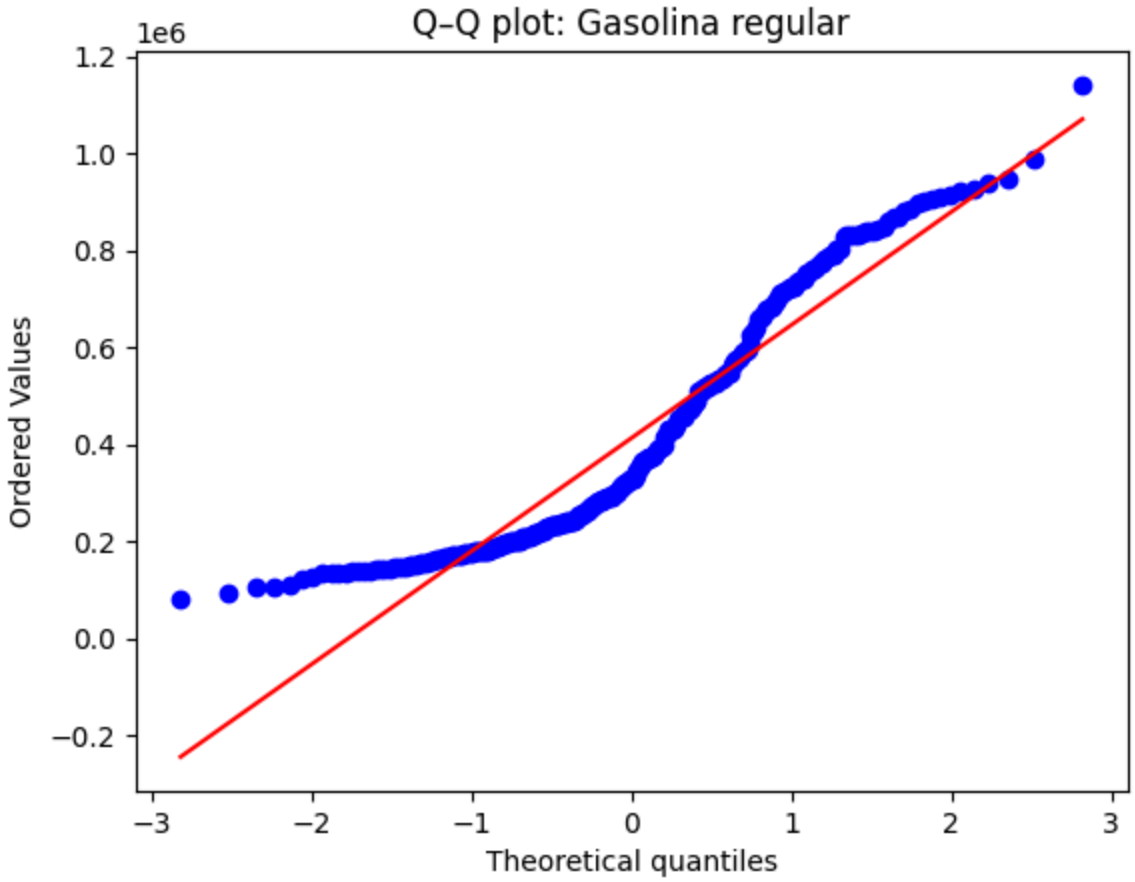
```
Gasolina regular: dtype=float64
  únicos: 288 de 288 (100.00%)
  ⇒ parece CONTINUA (muchos valores únicos)

Gasolina superior: dtype=float64
  únicos: 288 de 288 (100.00%)
  ⇒ parece CONTINUA (muchos valores únicos)

Diesel: dtype=float64
  únicos: 288 de 288 (100.00%)
  ⇒ parece CONTINUA (muchos valores únicos)
```

Histogramas, Q–Q plots y test de normalidad

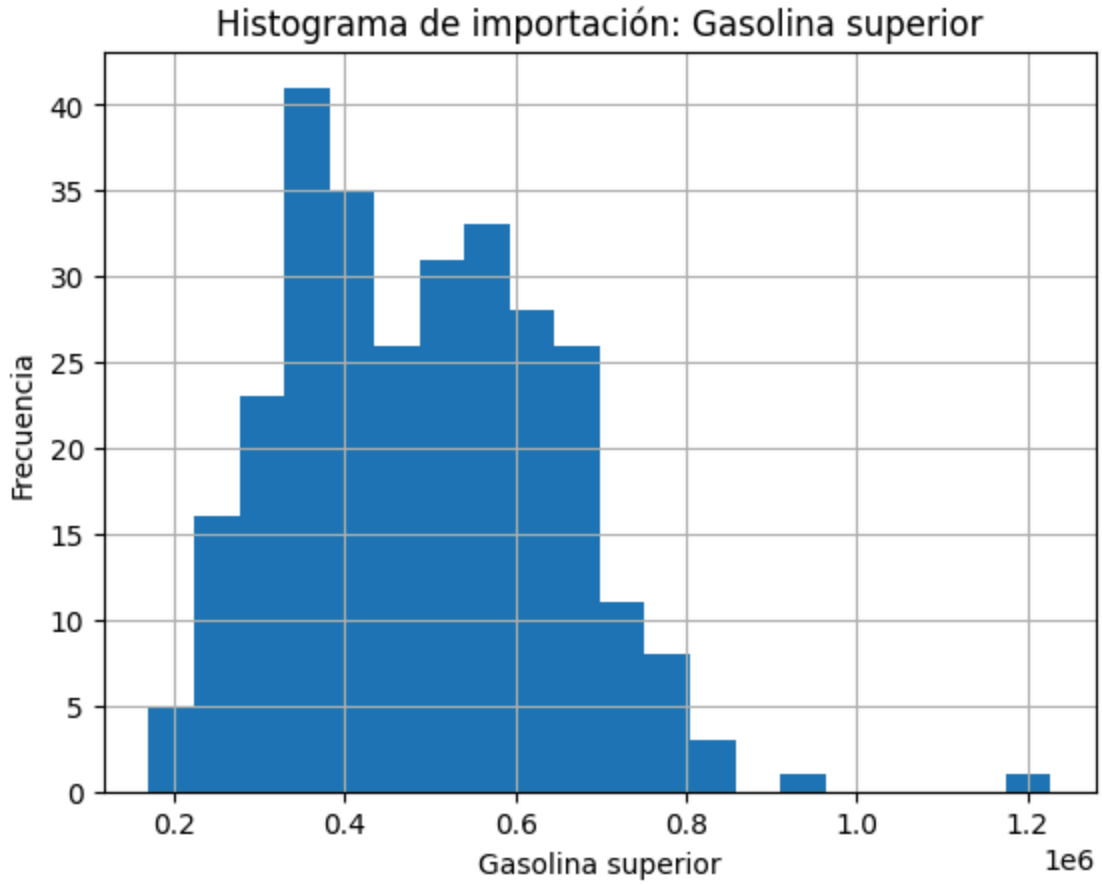
In [54]:
```
for c in cols:
    plt.figure()
    df[c].hist(bins=20)
    plt.title(f'Histograma de importación: {c}')
    plt.xlabel(c); plt.ylabel('Frecuencia')
    plt.show()

    plt.figure()
    stats.probplot(df[c], dist="norm", plot=plt)
    plt.title(f'Q–Q plot: {c}')
    plt.show()
```

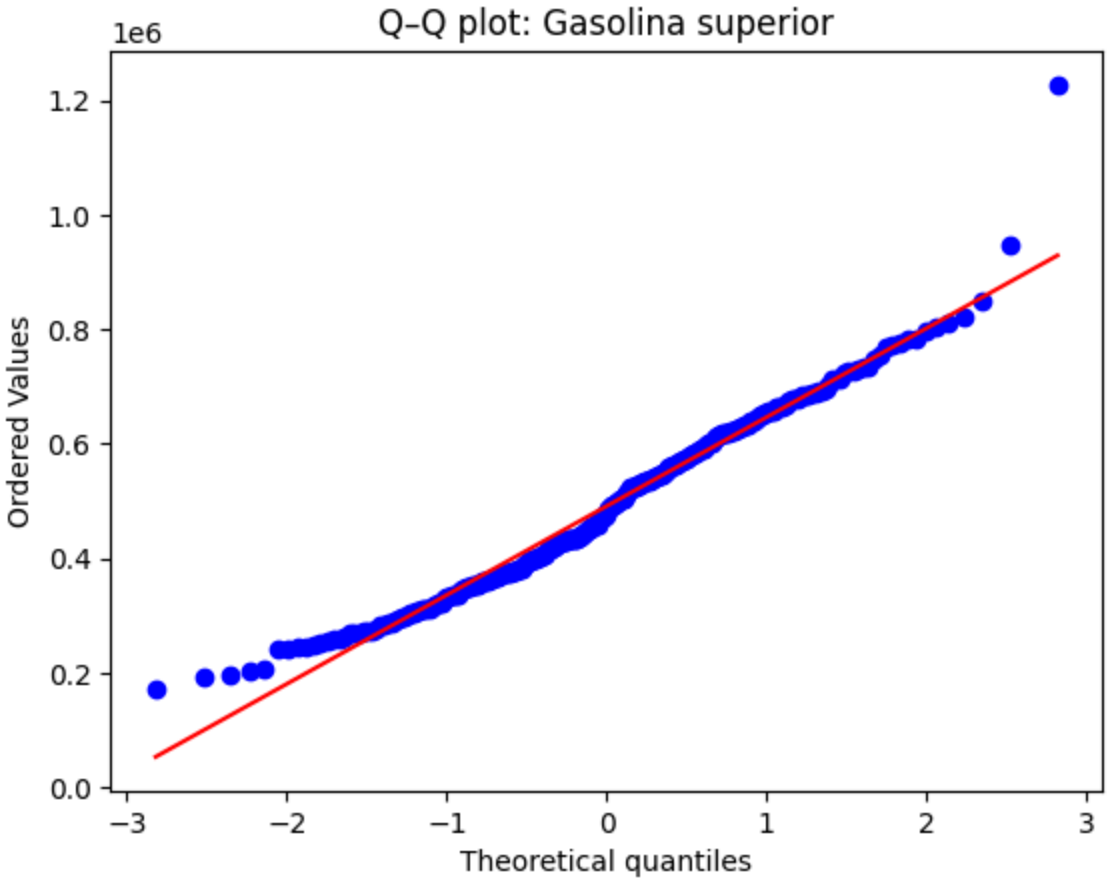
```
    W, p = stats.shapiro(df[c])
    print(f"Shapiro-Wilk para {c}: W={W:.4f}, p-value={p:.4f}\n")
```



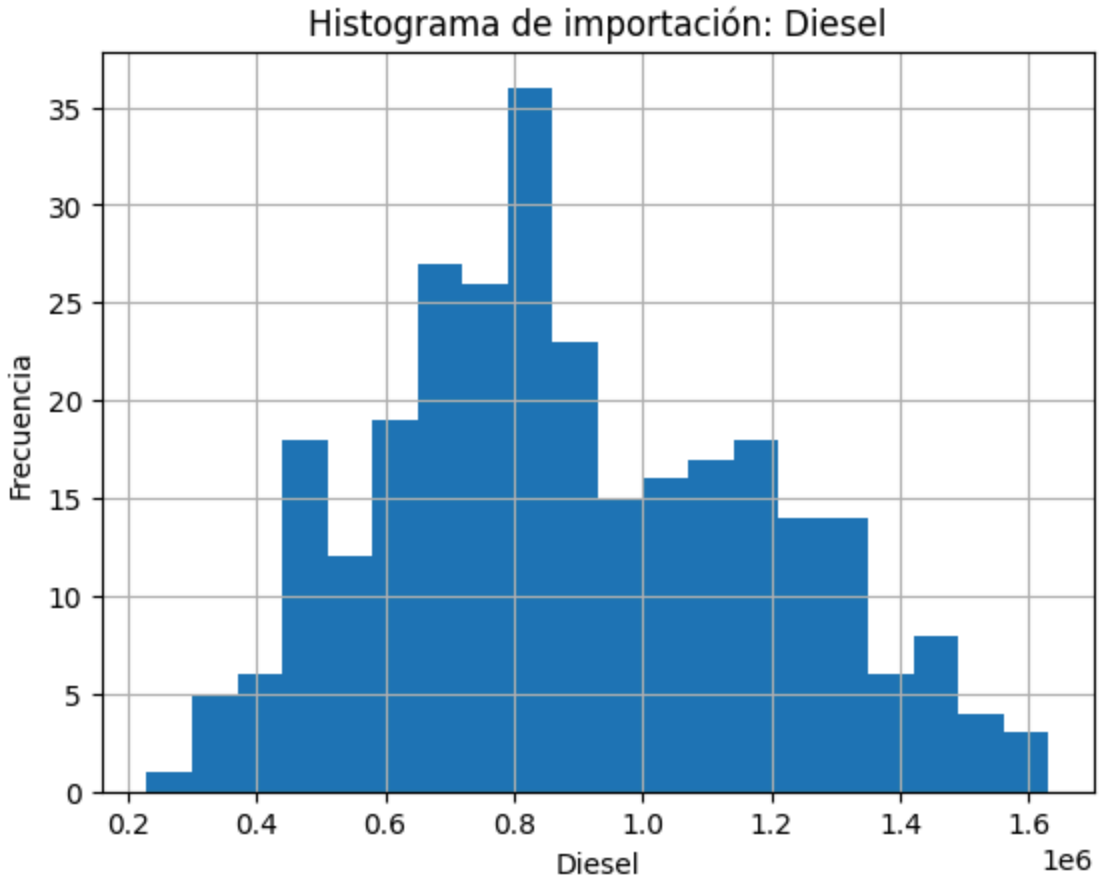


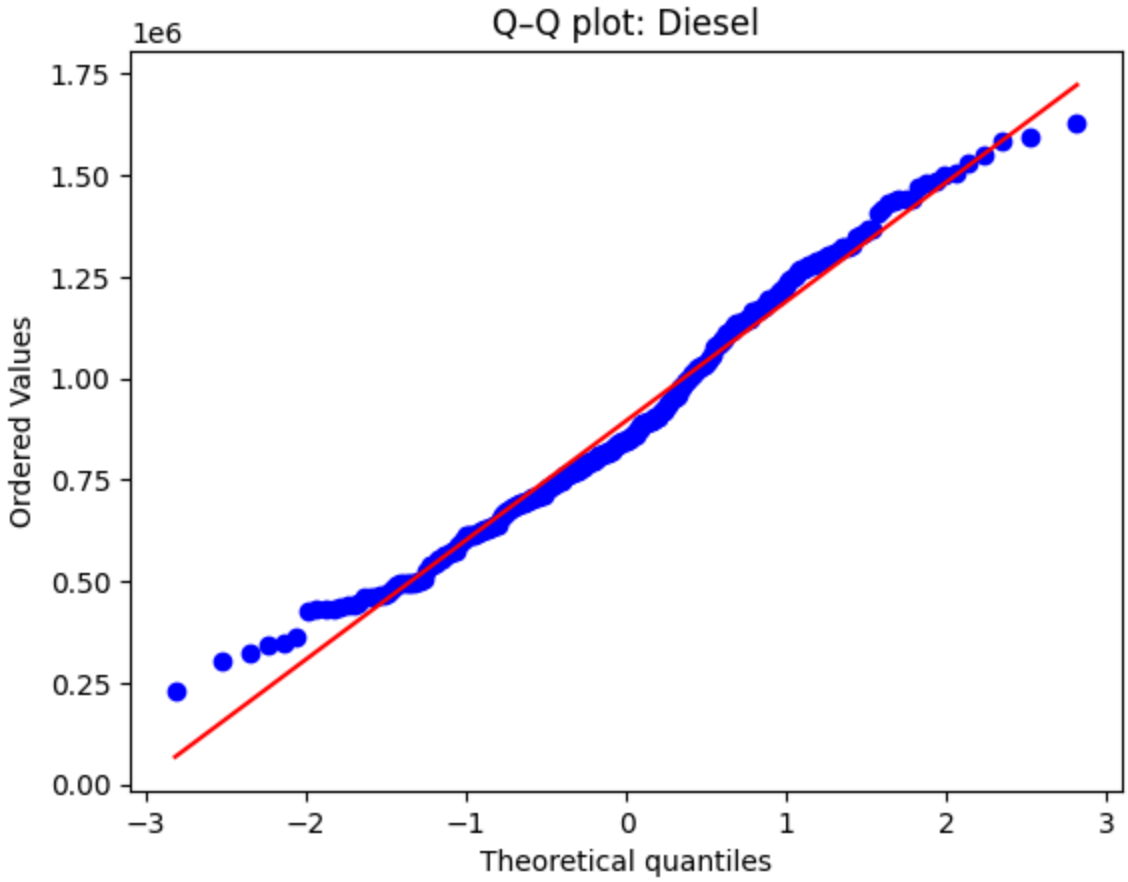

```
Shapiro–Wilk para Gasolina regular: W=0.9050, p-value=0.0000
```






```
Shapiro–Wilk para Gasolina superior: W=0.9737, p-value=0.0000
```

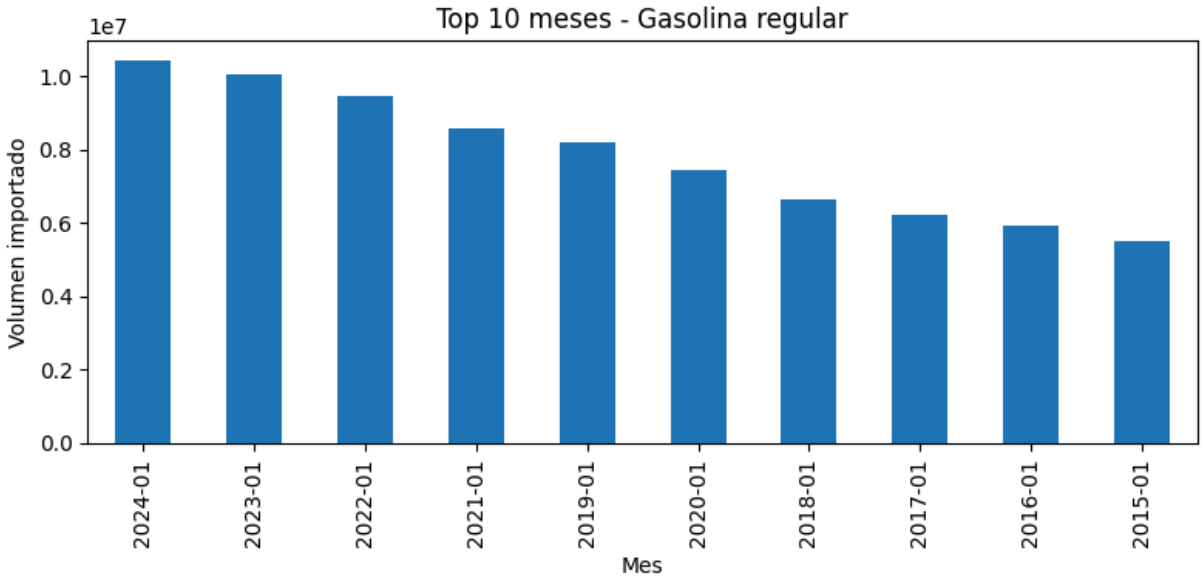


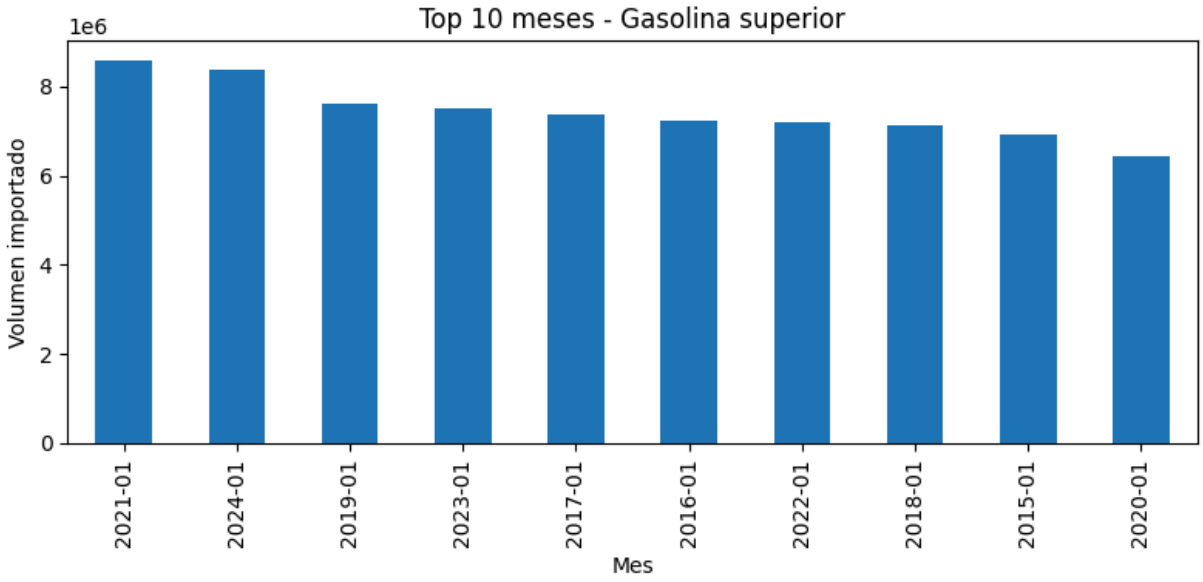


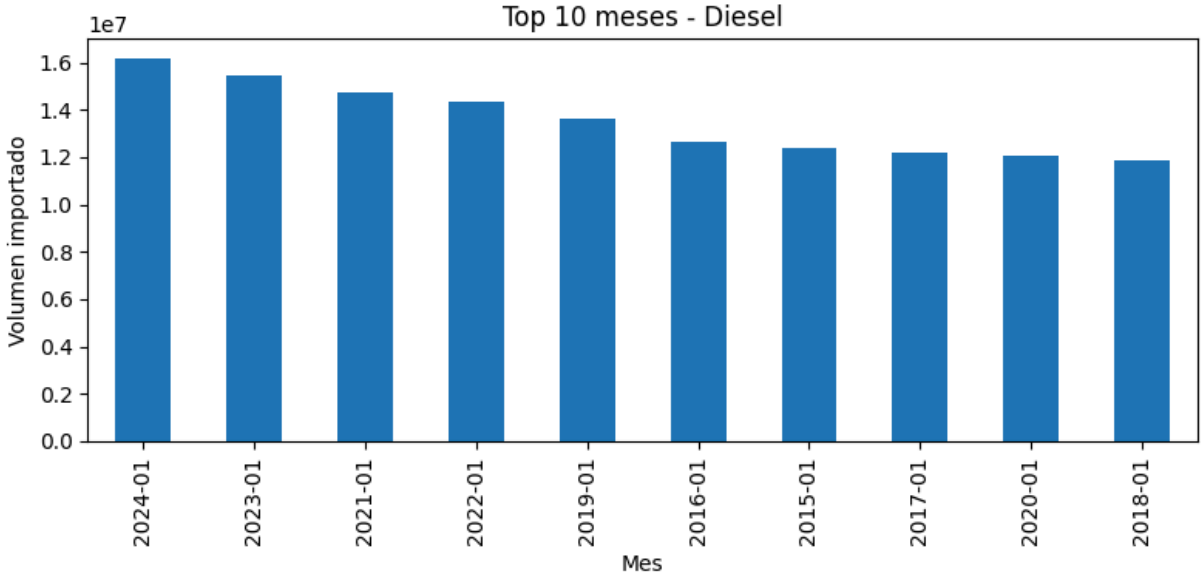

```
Shapiro-Wilk para Diesel: W=0.9820, p-value=0.0011
```

Meses con más importación por tipo

In [56]:
```
df['Mes'] = df['Fecha'].dt.to_period('M')
monthly = df.groupby('Mes')[cols].sum()

for c in cols:
    top = monthly[c].nlargest(10)
    top.plot(kind='bar', figsize=(8,4), title=f"Top 10 meses - {c}")
    plt.xlabel('Mes'); plt.ylabel('Volumen importado')
    plt.tight_layout(); plt.show()
```

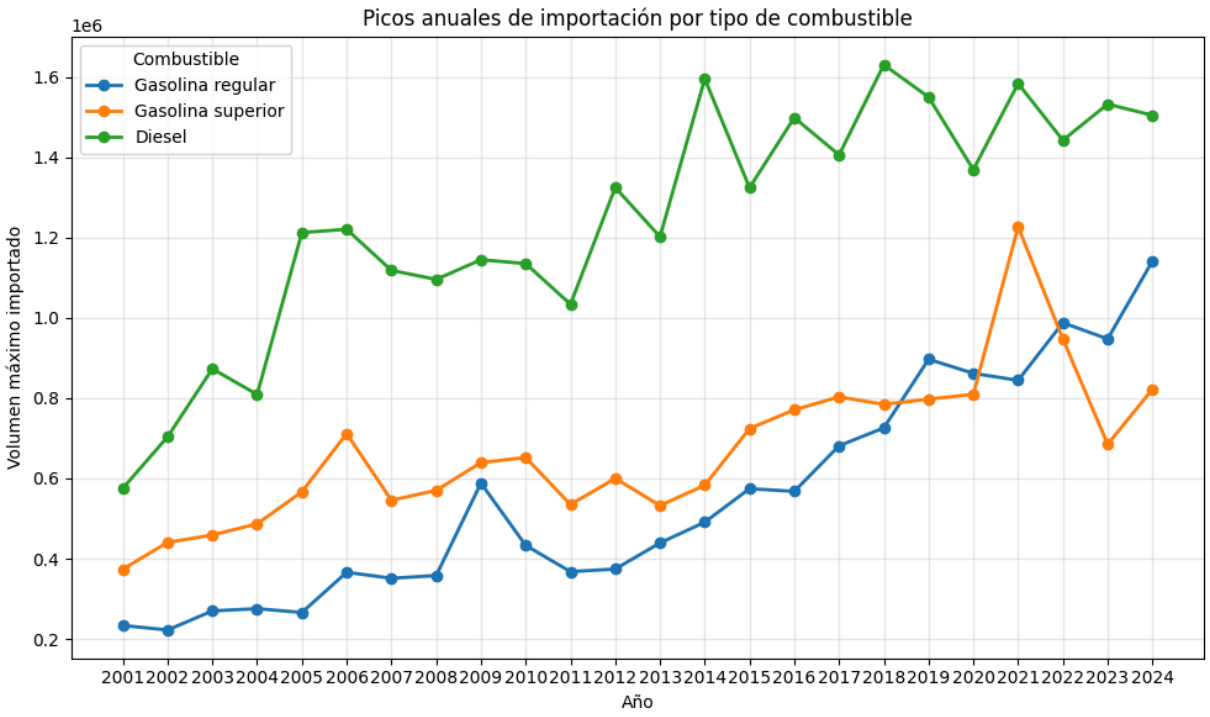

Top 10 meses - Gasolina regular
1e7
Volumen importado
0.0
0.2
0.4
0.6
0.8
1.0
2024-01
2023-01
2022-01
2021-01
2019-01
2020-01
2018-01
2017-01
2016-01
2015-01
Mes


Top 10 meses - Gasolina superior
1e6
Volumen importado
0
2
4
6
8
2021-01
2024-01
2019-01
2023-01
2017-01
2016-01
2022-01
2018-01
2015-01
2020-01
Mes


Top 10 meses - Diesel
1e7
Volumen importado
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
2024-01
2023-01
2021-01
2022-01
2019-01
2016-01
2015-01
2017-01
2020-01
2018-01
Mes

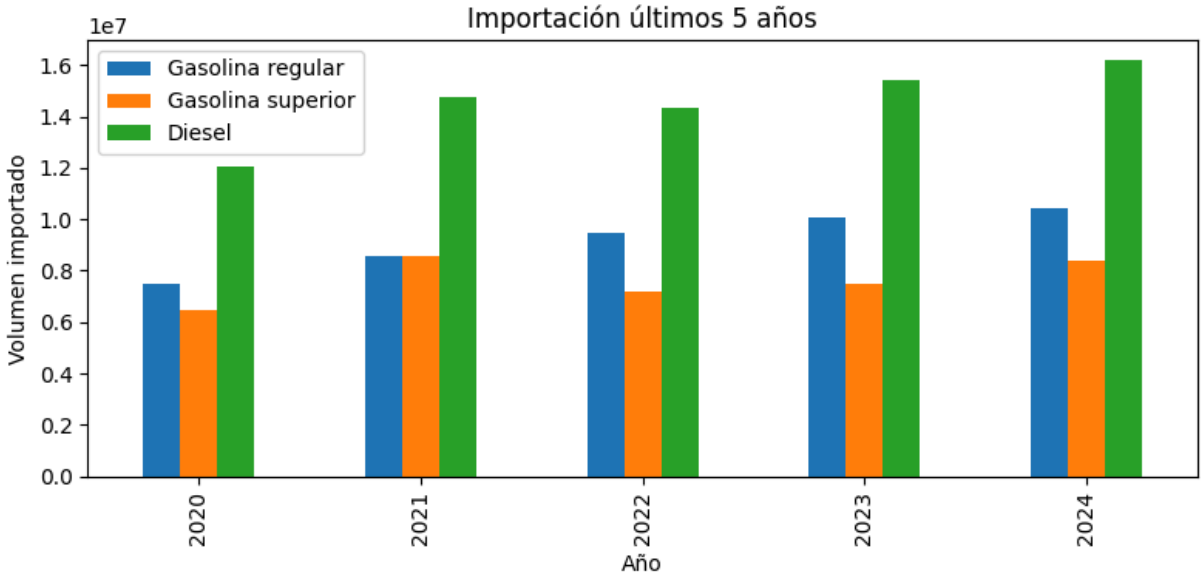
Picos anuales por tipo de combustible

In [61]:
```
df['Año'] = df['Fecha'].dt.year
picos_anuales = df.groupby('Año')[cols].max()
años = picos_anuales.index.astype(int)

plt.figure(figsize=(10,6))
for c in cols:
    plt.plot(años, picos_anuales[c], marker='o', linewidth=2, label=c)

plt.title('Picos anuales de importación por tipo de combustible')
plt.xlabel('Año')
plt.ylabel('Volumen máximo importado')
plt.xticks(años)
plt.legend(title='Combustible')
plt.grid(alpha=0.3)
plt.tight_layout()
plt.show()
```



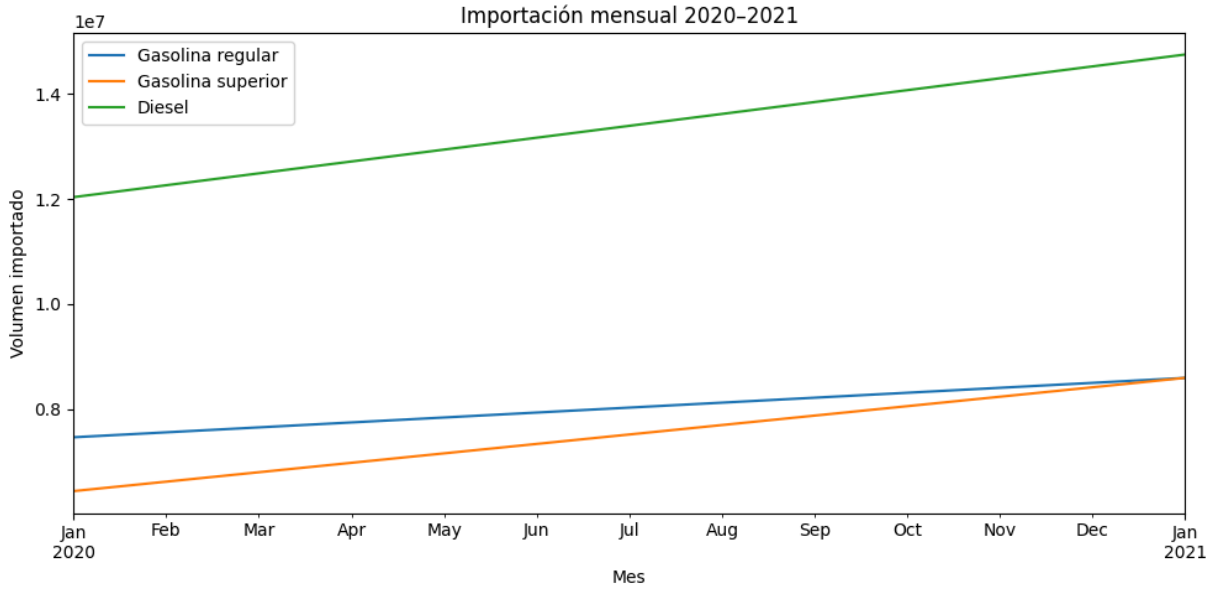
Evolución últimos 5 años

In [59]:
```
ultimo = df['Año'].max()
ult5 = df[df['Año'] >= ultimo - 4].groupby('Año')[cols].sum()
ult5.plot(kind='bar', figsize=(8,4), title='Importación últimos 5 años')
plt.xlabel('Año'); plt.ylabel('Volumen importado')
plt.tight_layout(); plt.show()
```



Comportamiento durante la pandemia (2020–2021)

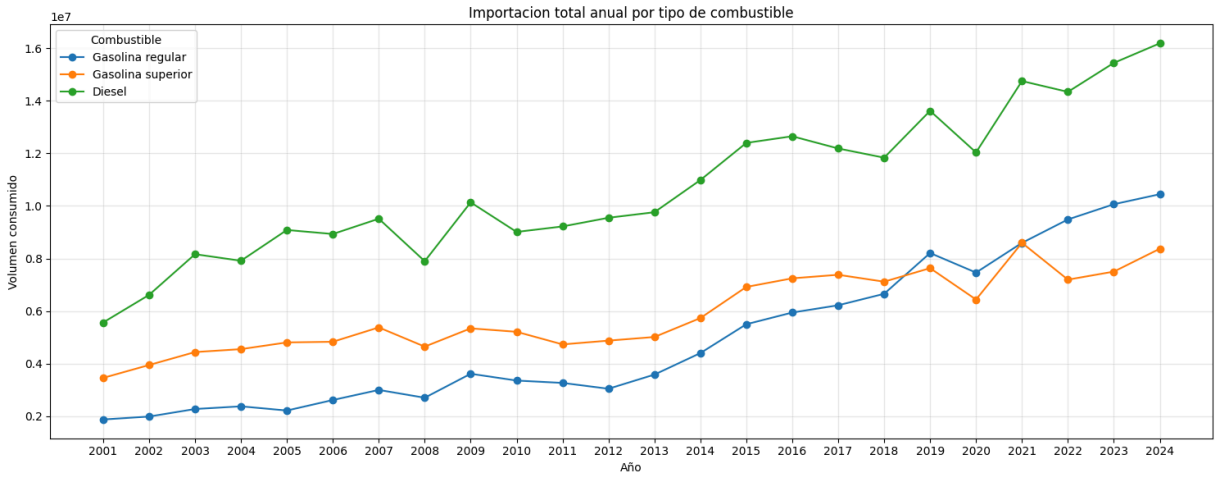
In [60]:
```
pandemia = df[df['Año'].isin([2020, 2021])].groupby('Mes')[cols].sum()
pandemia.plot(figsize=(10,5), title='Importación mensual 2020–2021')
plt.xlabel('Mes'); plt.ylabel('Volumen importado')
plt.tight_layout(); plt.show()
```



Importacion total

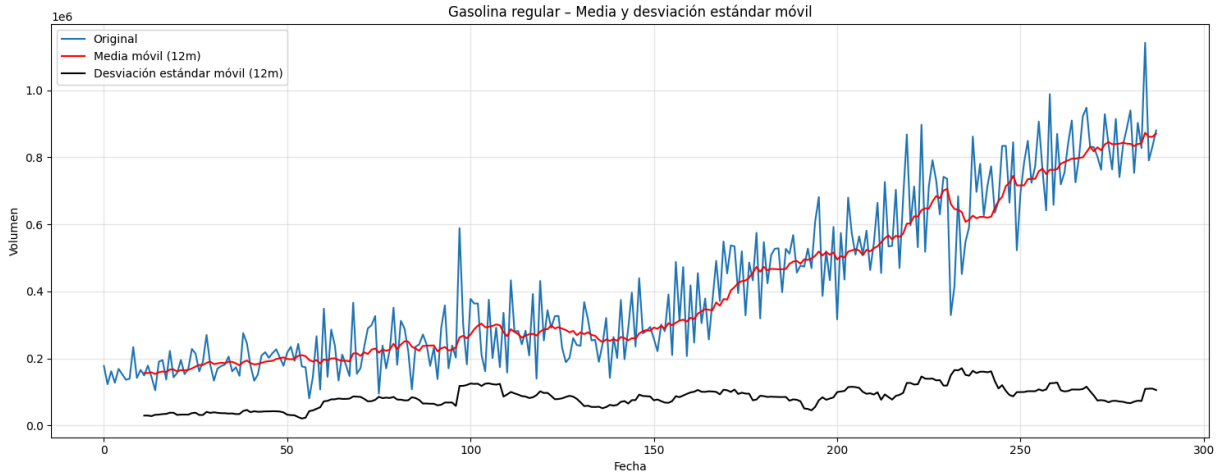
In [65]:
```
cols = ['Gasolina regular', 'Gasolina superior', 'Diesel']
yearly = df.groupby('Año')[cols].sum()

plt.figure(figsize=(15,6))
for c in cols:
    plt.plot(yearly.index, yearly[c], marker='o', label=c)
```

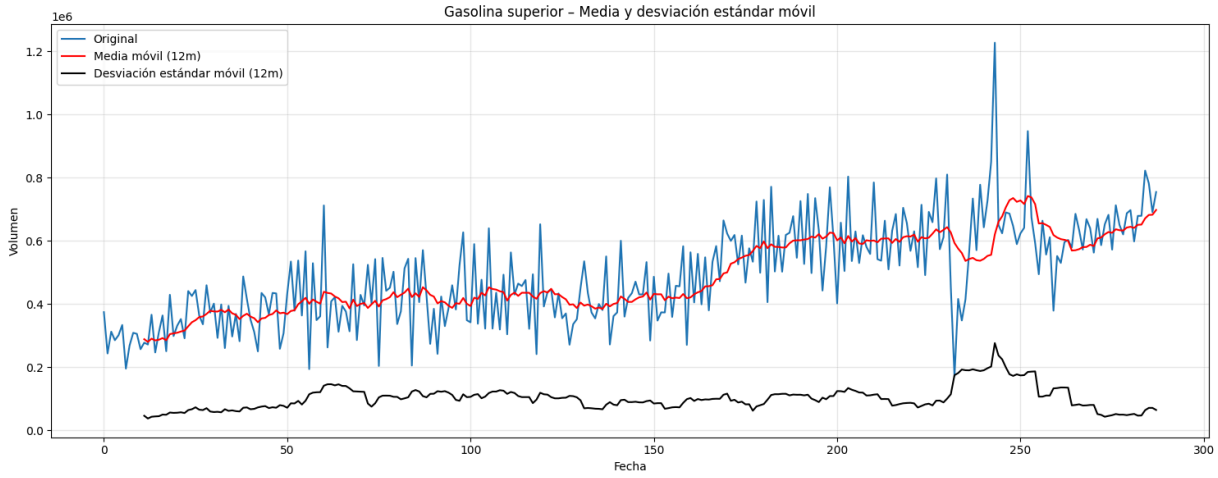
```
plt.title('Importacion total anual por tipo de combustible')
plt.xlabel('Año')
plt.ylabel('Volumen consumido')
plt.xticks(yearly.index)
plt.legend(title='Combustible')
plt.grid(alpha=0.3)
plt.tight_layout()
plt.show()
```

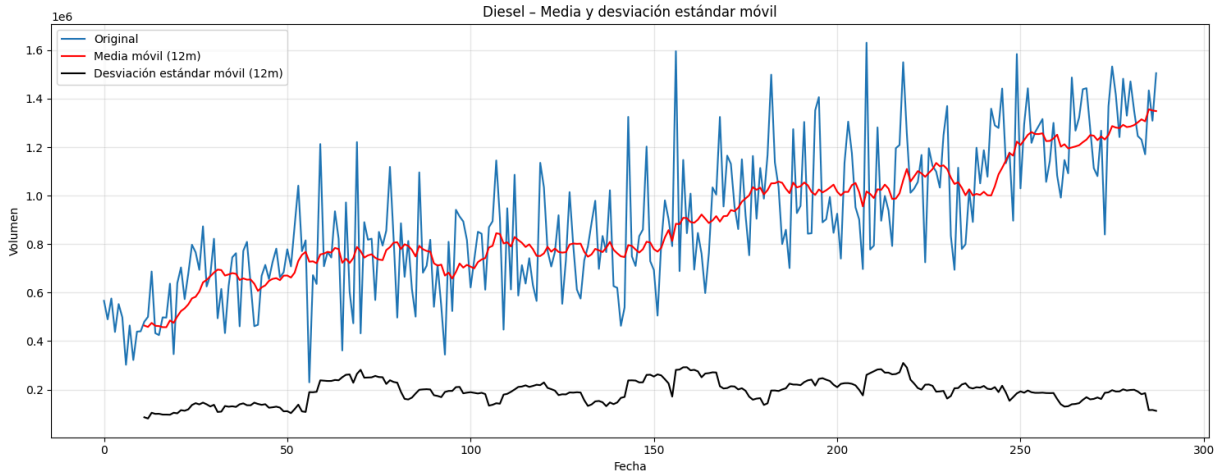


Media y desviacion estandar

In [66]:
```
cols = ['Gasolina regular', 'Gasolina superior', 'Diesel']
window = 12  # meses

# Generar un gráfico por cada tipo de combustible
for c in cols:
    ts = df[c].dropna()
    roll_mean = ts.rolling(window).mean()
    roll_std  = ts.rolling(window).std()

    plt.figure(figsize=(15,6))
    plt.plot(ts.index, ts, label='Original')
    plt.plot(roll_mean.index, roll_mean, color='red', label=f'Media móvil ({window}
    plt.plot(roll_std.index, roll_std, color='black', label=f'Desviación estándar m
    plt.title(f'{c} – Media y desviación estándar móvil')
    plt.xlabel('Fecha')
    plt.ylabel('Volumen')
    plt.legend()
    plt.grid(alpha=0.3)
    plt.tight_layout()
    plt.show()
```





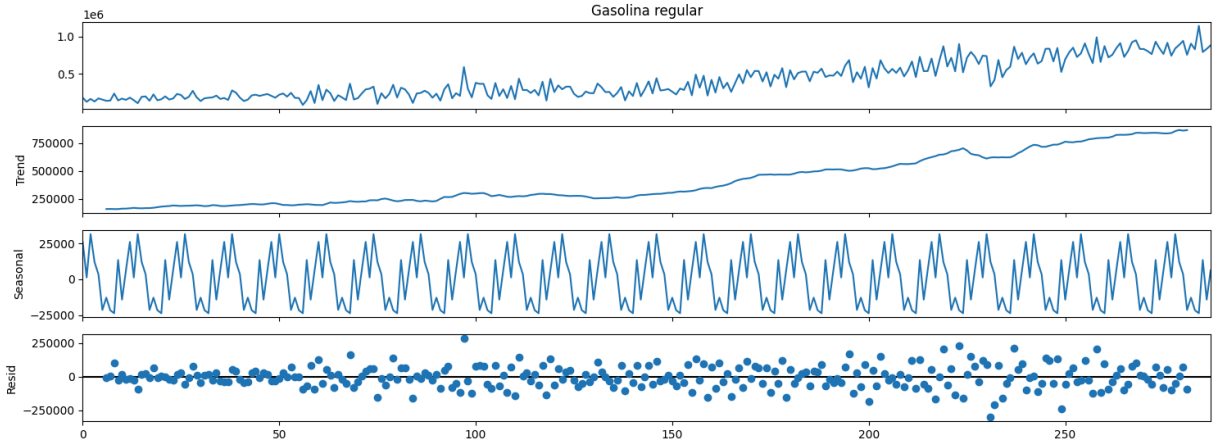


DESCOMPOSICION ADITIVA

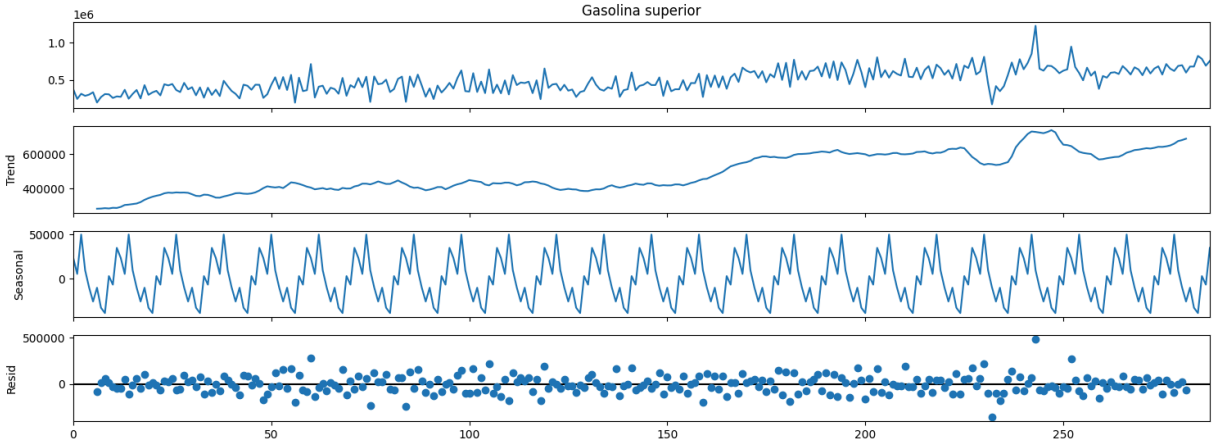
In [ ]:
```
for c in cols:
    ts = df[c].dropna()
    result = seasonal_decompose(ts, model='additive', period=window)

    fig = result.plot()
    fig.set_size_inches(15, 6)

    fig.suptitle(f'Descomposición aditiva – {c}', fontsize=16)
```

```
    plt.tight_layout()
    plt.show()
```

Descomposición aditiva – Gasolina regular



Descomposición aditiva – Gasolina superior



Descomposición aditiva – Diesel