Refining Sector Fitness Check Step 1

Tracy Ellerington

24 February 2015

Solomon Associates
M³ – Measure. Manage. Maximize.®

Solomon Databases
for Benchmarking

We show clients where their operations stand against the spectrum of global competition.

Our data are proprietary, not pulled from inconsistent, publicly available sources.

Solomon verifies input to its databases, ensuring consistency during each study.

99% of European refinery companies participated in the studies regularly within the Fitness Check time period.

EU Fitness Check
Step 1 Data

Only data provided by the refineries to Solomon are included in the Fuels Studies.

Solomon does not adjust the raw data, which are supplied and owned by the refineries themselves.

Peer Groups

EU-28

- EU-15 and EU-13

Nine Geographical Regions

- Baltic (BAL) – Denmark, Finland, Sweden, Lithuania
- Benelux (BNX) – Belgium, Netherlands
- Germany (GER)
- Central Europe (CEU) – Austria, Czech Republic, Hungary, Poland, Slovakia
- UK & Ireland (UKI)
- France (FRA)
- Iberia (IBE) – Spain, Portugal
- Mediterranean – Italy, Greece
- South East Europe (SEE) – Bulgaria, Romania, Croatia

Five Complexity Groups

Petrochemical Integrated Sites

Five Complexity Groups

Complexity Factor defined as

$$\frac{Process\ EDC\ (bbl/d)}{Total\ Crude\ Capacity\ (bbl/d)}$$

$$Process\ EDC = \sum Unit\ Capacity \times EDC\ Factor$$

Hydroskimming + Thermal Units

1. Visbreaker and Thermal Cracker

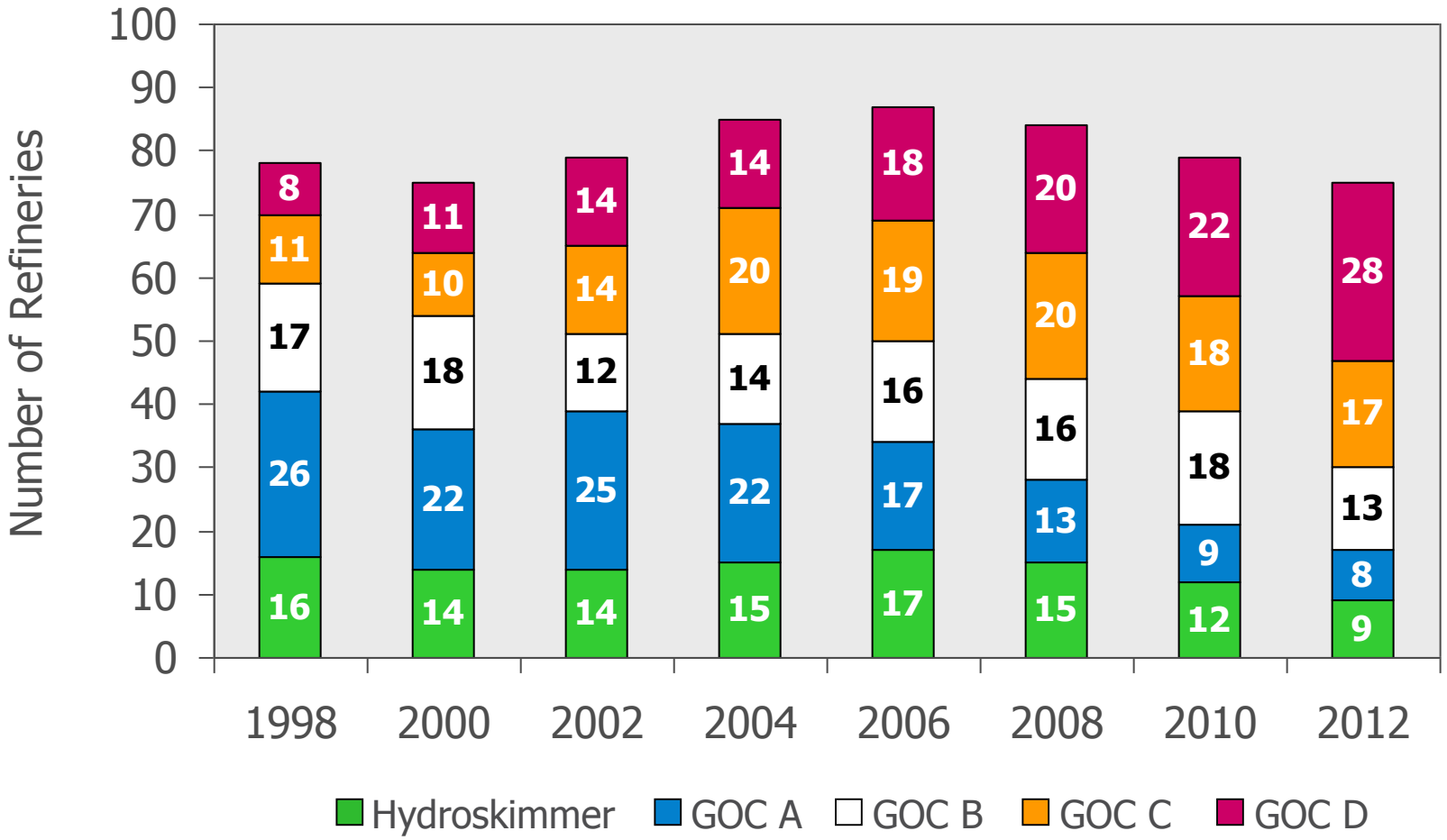
Gasoil Conversion (GOC) Split by Complexity Factor

2. GOC A Complexity Factor <6.9
3. GOC B 6.9 ≤ Complexity Factor <8.0
4. GOC C 8.0 ≤ Complexity Factor <9.5
5. GOC D 9.5 ≤ Complexity Factor

GOC groups were set to have an equal split in 2006;ensure that in 2012 and 1998, no group was <5 refineries

Refinery Complexity

Study Operating Years 1998–2012



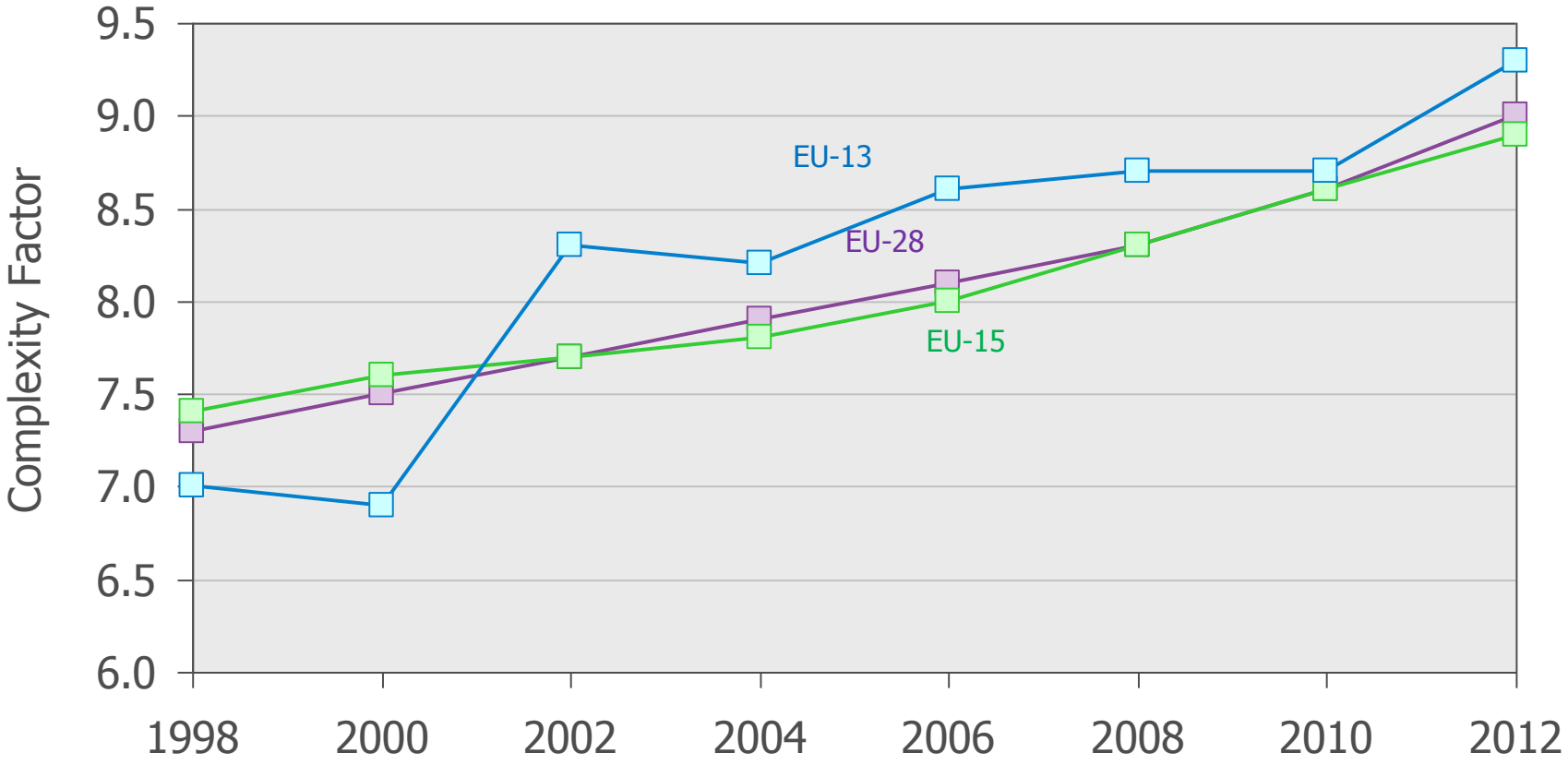
Refineries have become more complex, installing deep desulphurisation, hydrocrackers, cokers, etc.

Solomon Insights to Industry Trends (EU-28)

Solomon Associates
M³ — Measure. Manage. Maximize.®

Refineries Have Invested in Complexity

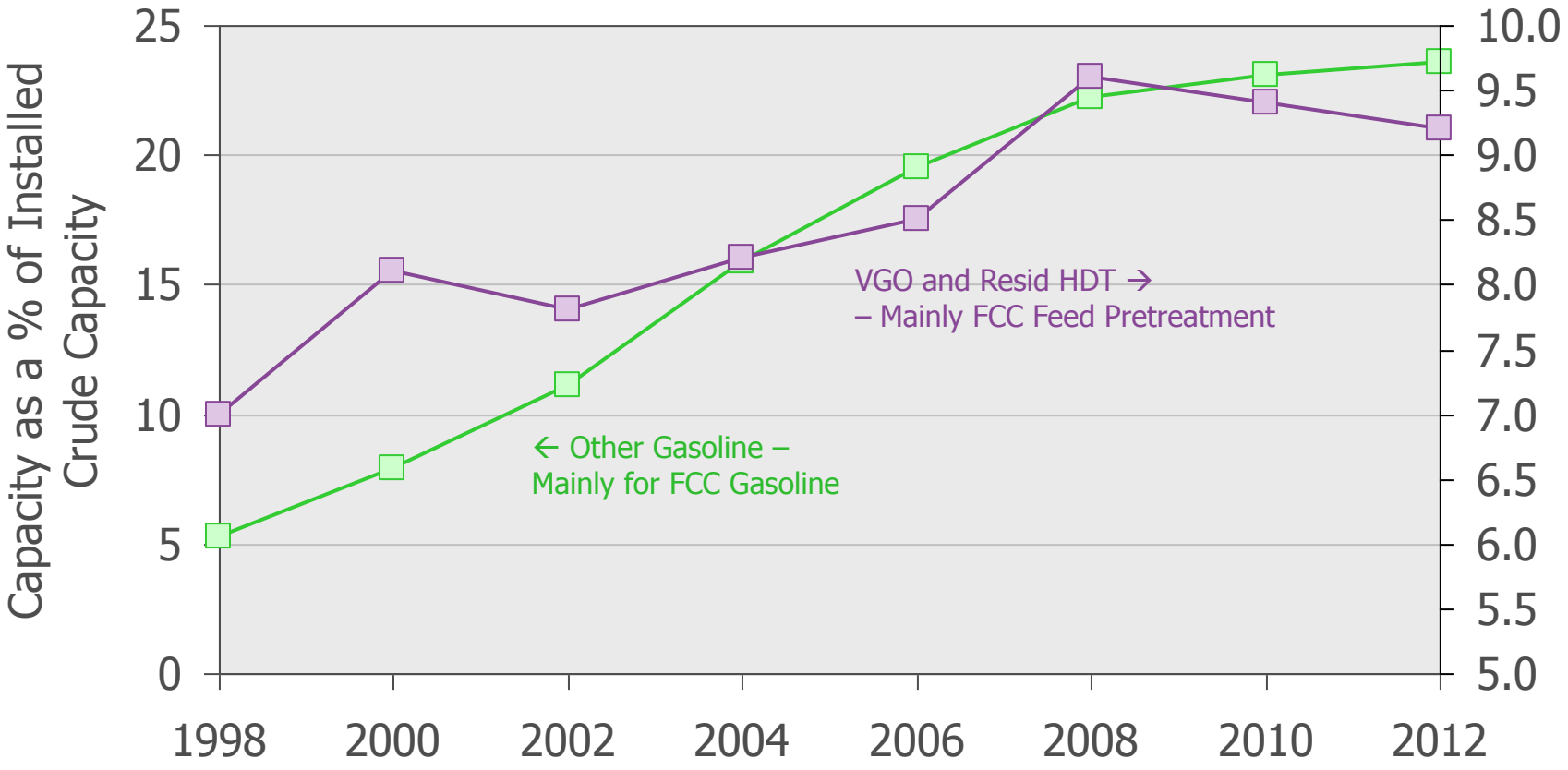
Complexity Factor for Study Operating Years 1998–2012



Overall crude sulfur (S) fairly constant, decline in early 2000s allowed refineries to put off investment in new units for Euro III

Meeting Gasoline Sulphur Specifications

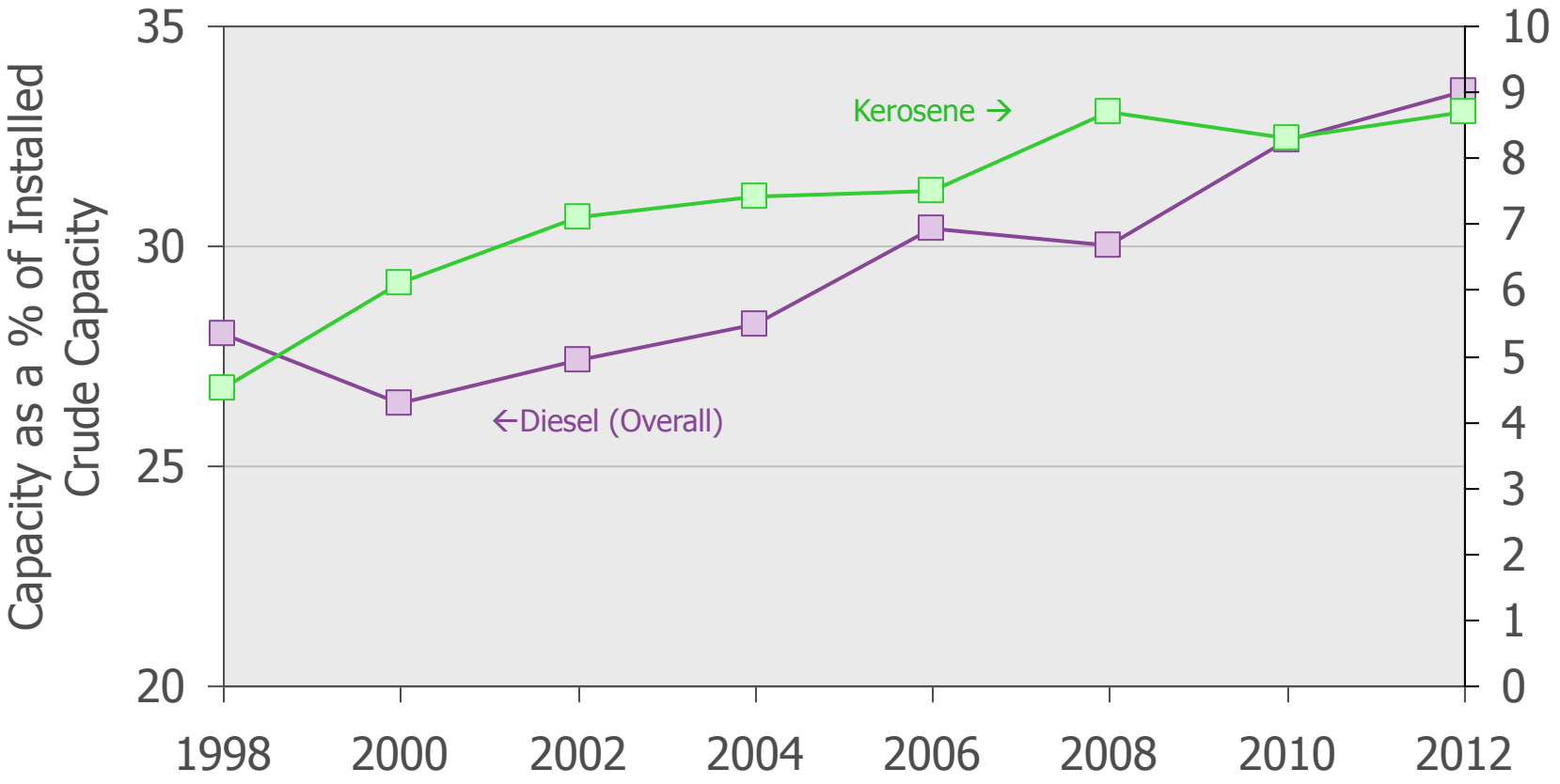
Study Operating Years 1998–2012 (EU-28)



Main source of sulphur in gasoline was from FCC gasoline

Distillate Sulphur Specifications

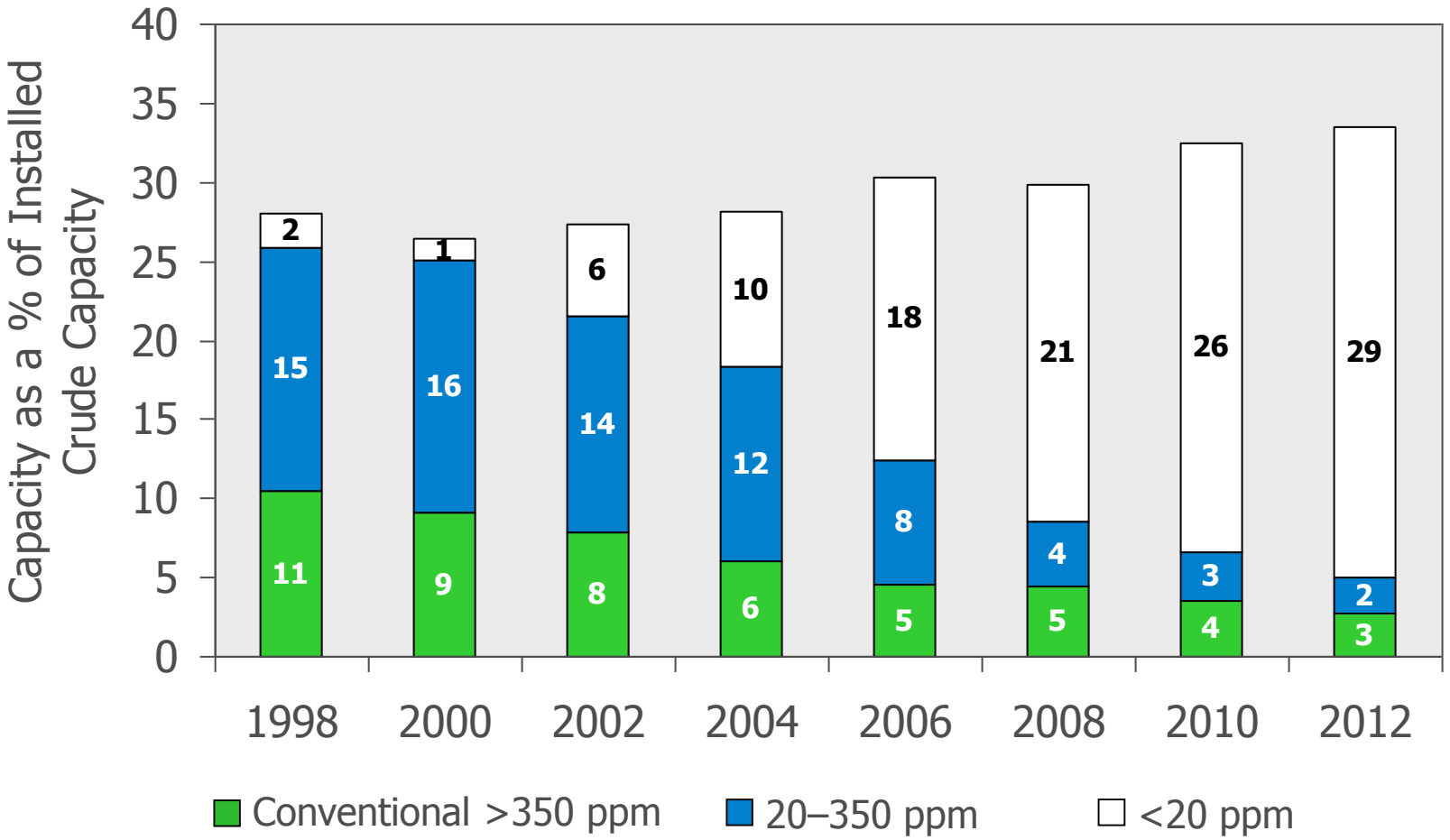
Study Operating Years 1998–2012 (EU-28)



To meet Euro IV and Euro V specifications

Diesel Desulphurisation

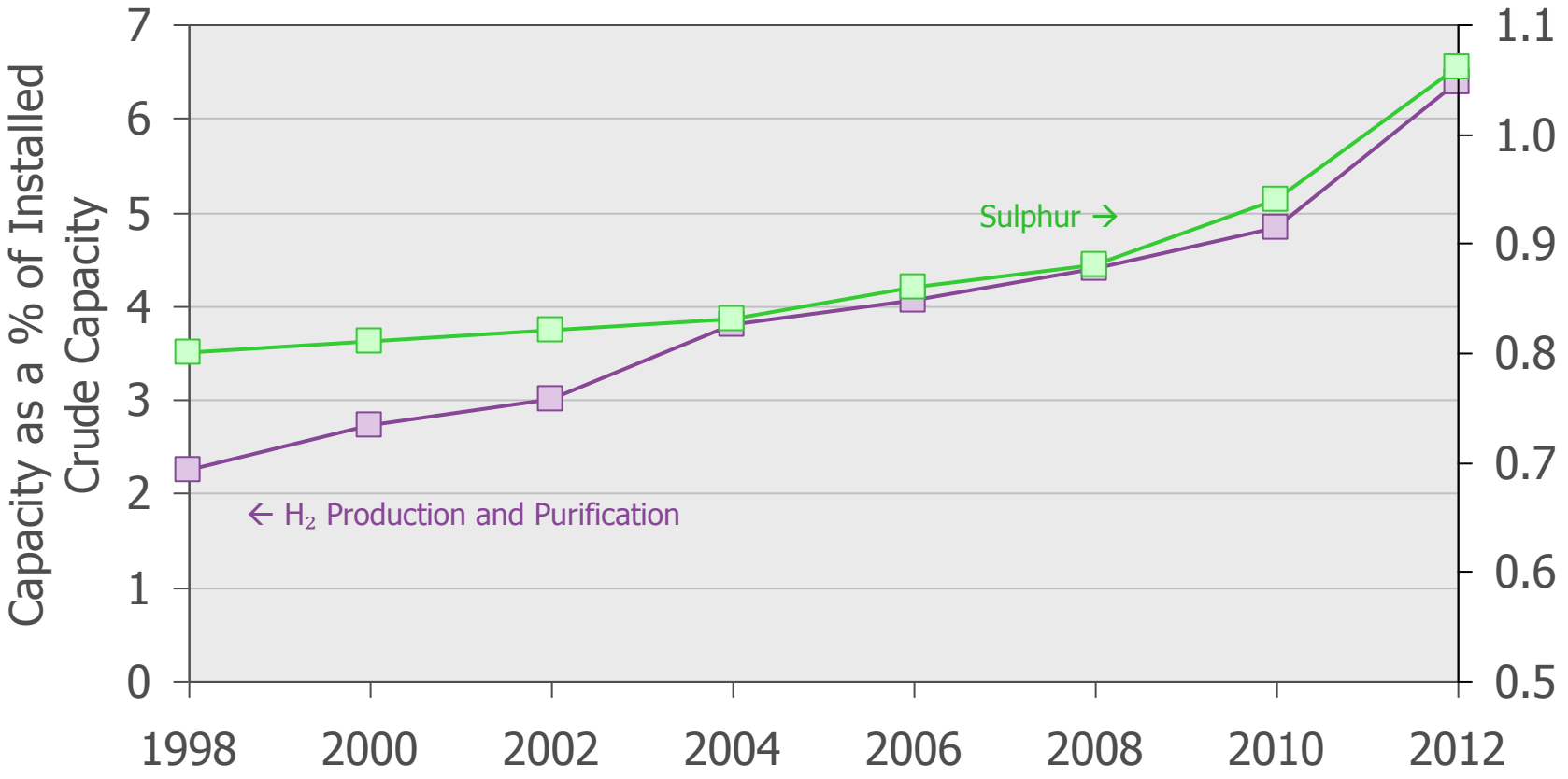
Study Operating Years 1998–2012



<20 ppm is Solomon global benchmark to cover global specifications; in European units, produce <10 ppm S diesel

Capacity of Hydrogen Plant Increases

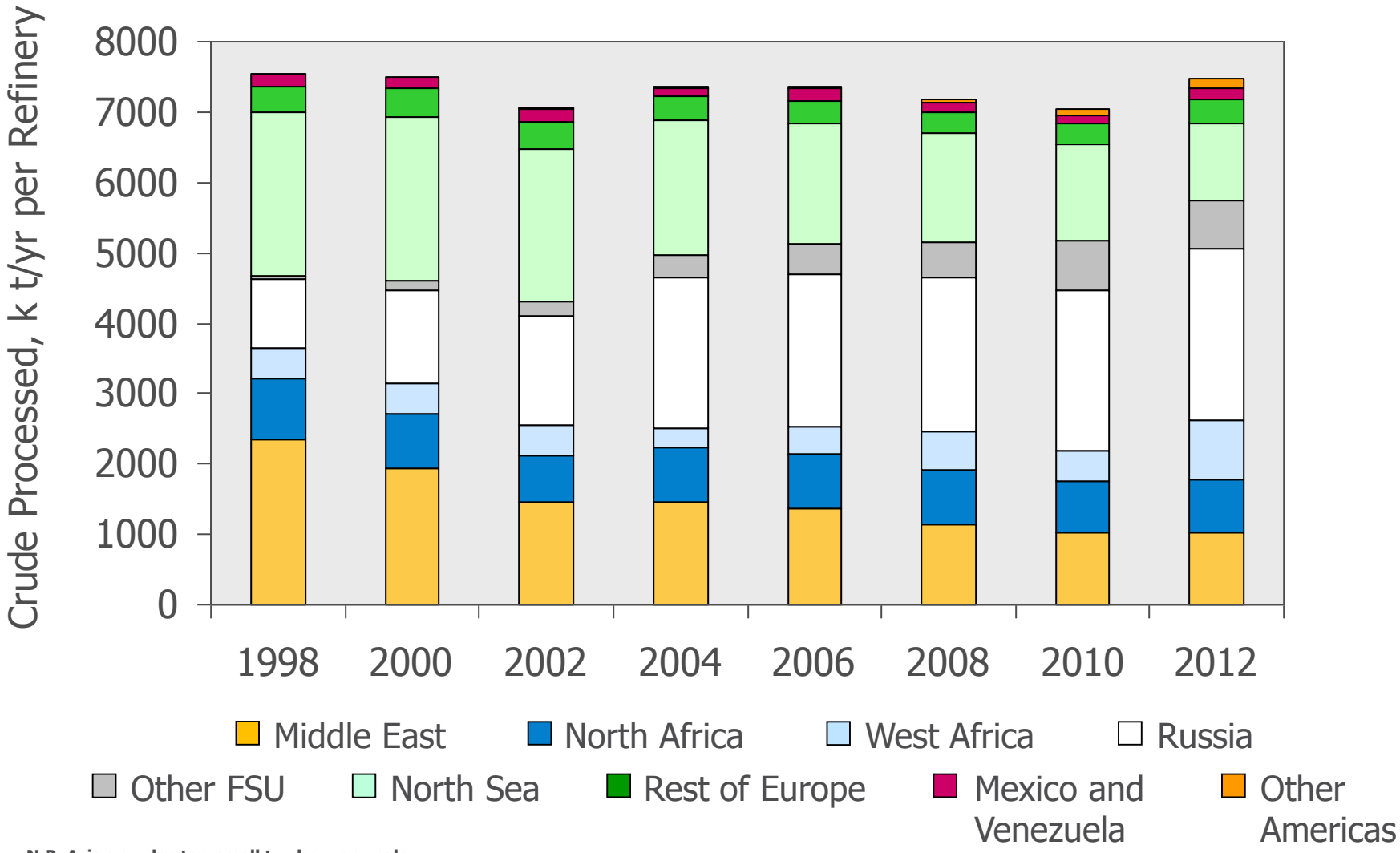
Study Operating Years 1998–2012 (EU-28)



Additional H_2 required for all HCR and additional HDT units, and more sulphur product as a result

Crudes Processed

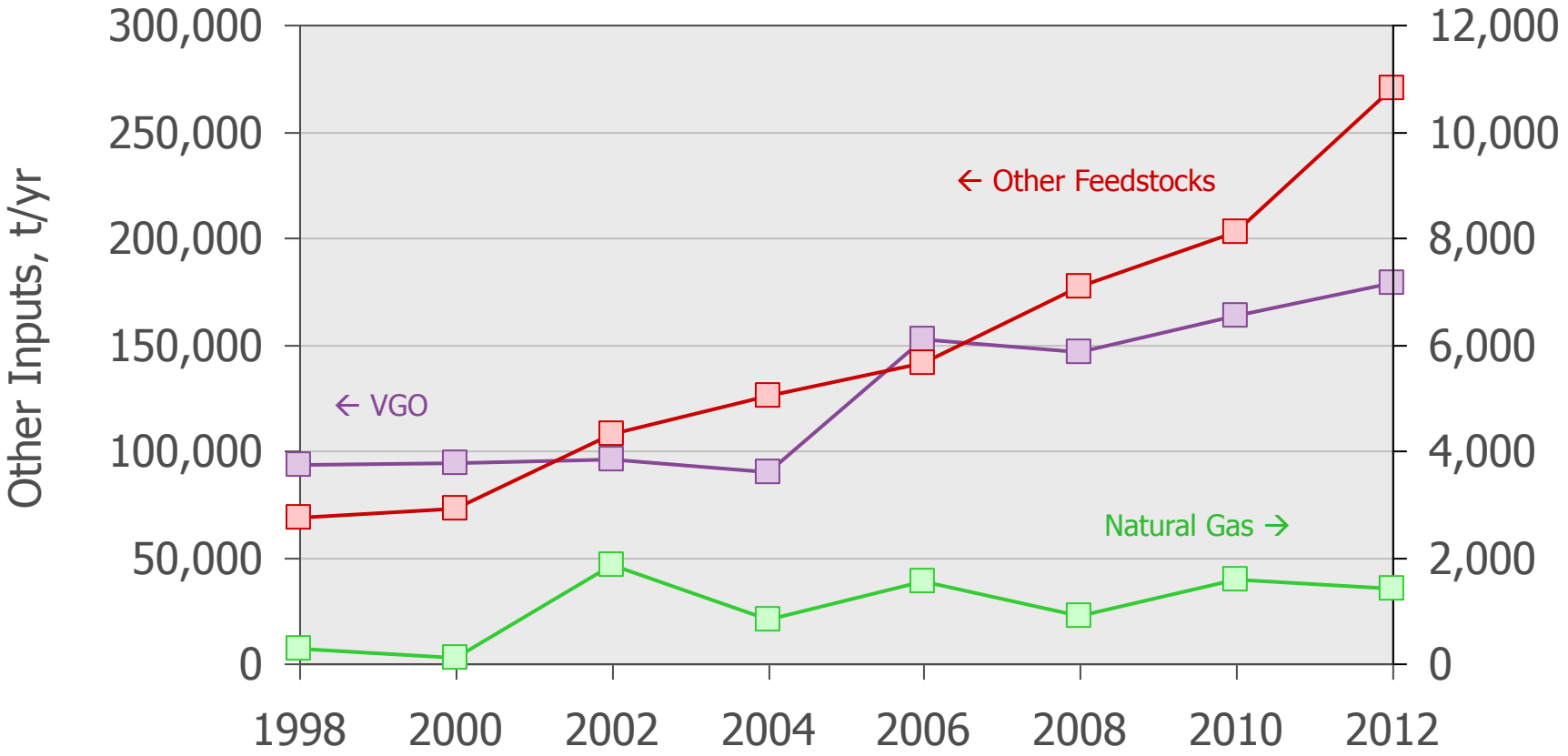
Study Operating Years 1998–2012 (EU-28)



N.B. Asian crudes too small to show on scale

Other Inputs

Study Operating Years 1998–2012 (EU-28)

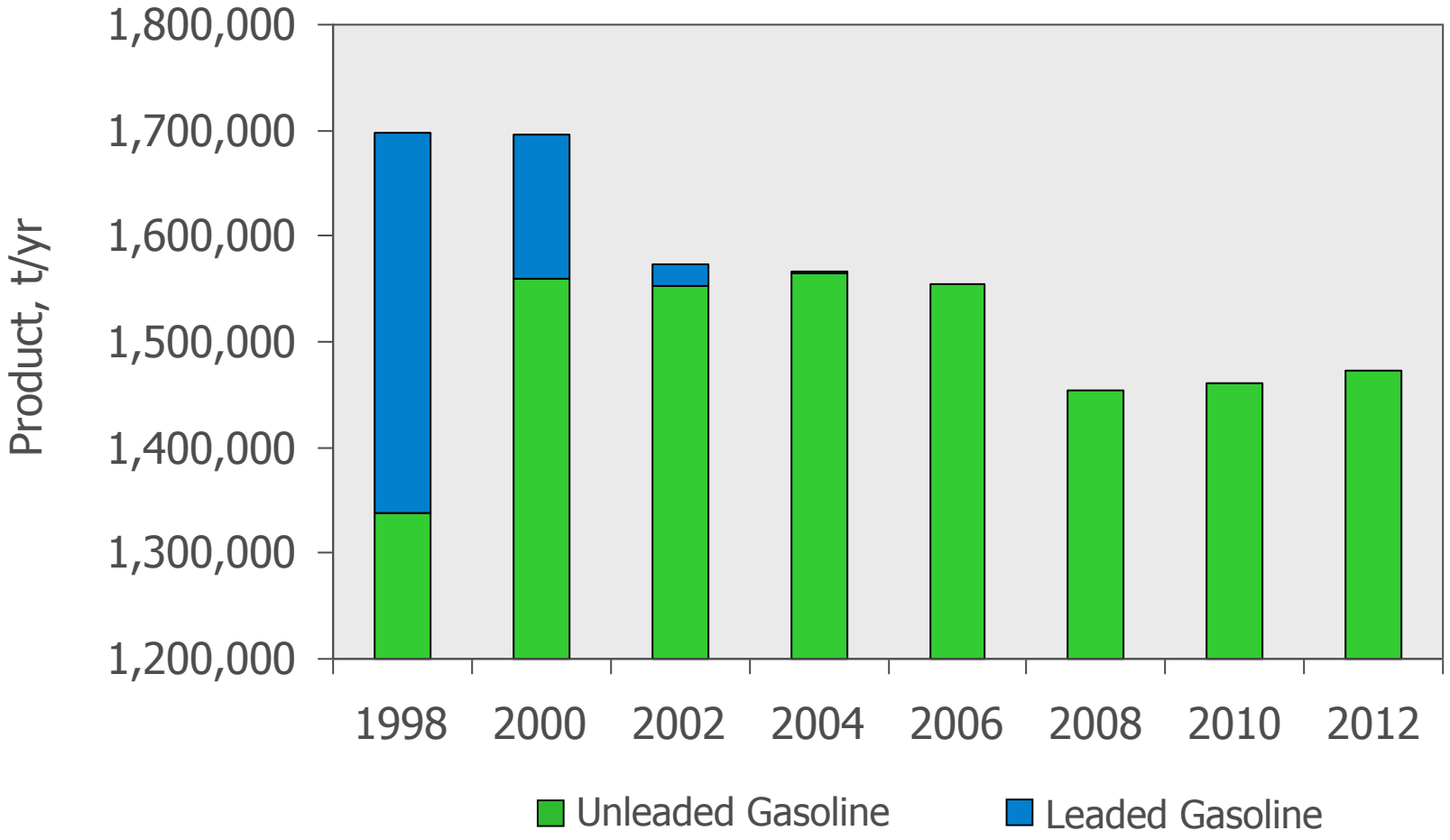


Products

Products in t/yr processed divided into following
Liquefied petroleum gas (LPG) (includes purer propane and butane products)
Propylene (refinery, chemical, polymer grades)
Gasoline (unleaded, leaded, aviation)
Jet fuels
Kerosene (excluding jet fuels)
Distillates • Diesel transportation fuel • Light heating or gas oil • Marine diesel
Marine bunker fuels • Non-cracked blends only • All other blends
Residual fuel • Five categories by wt % S • Extremely viscous
Miscellaneous products

Products, Gasoline

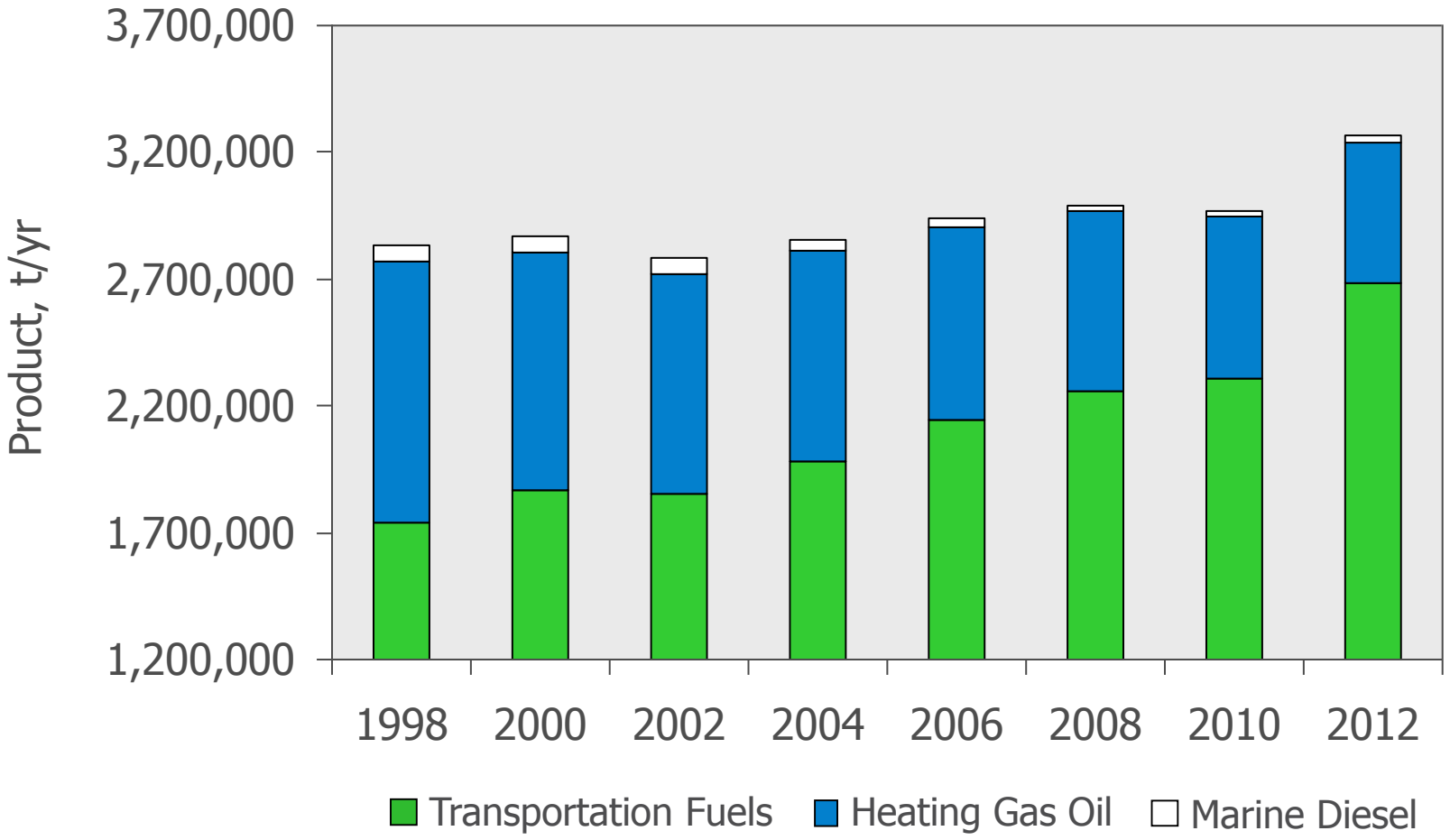
Study Operating Years 1998–2012 (EU-28)



N.B. Not zero on x-axis

Products, Distillates

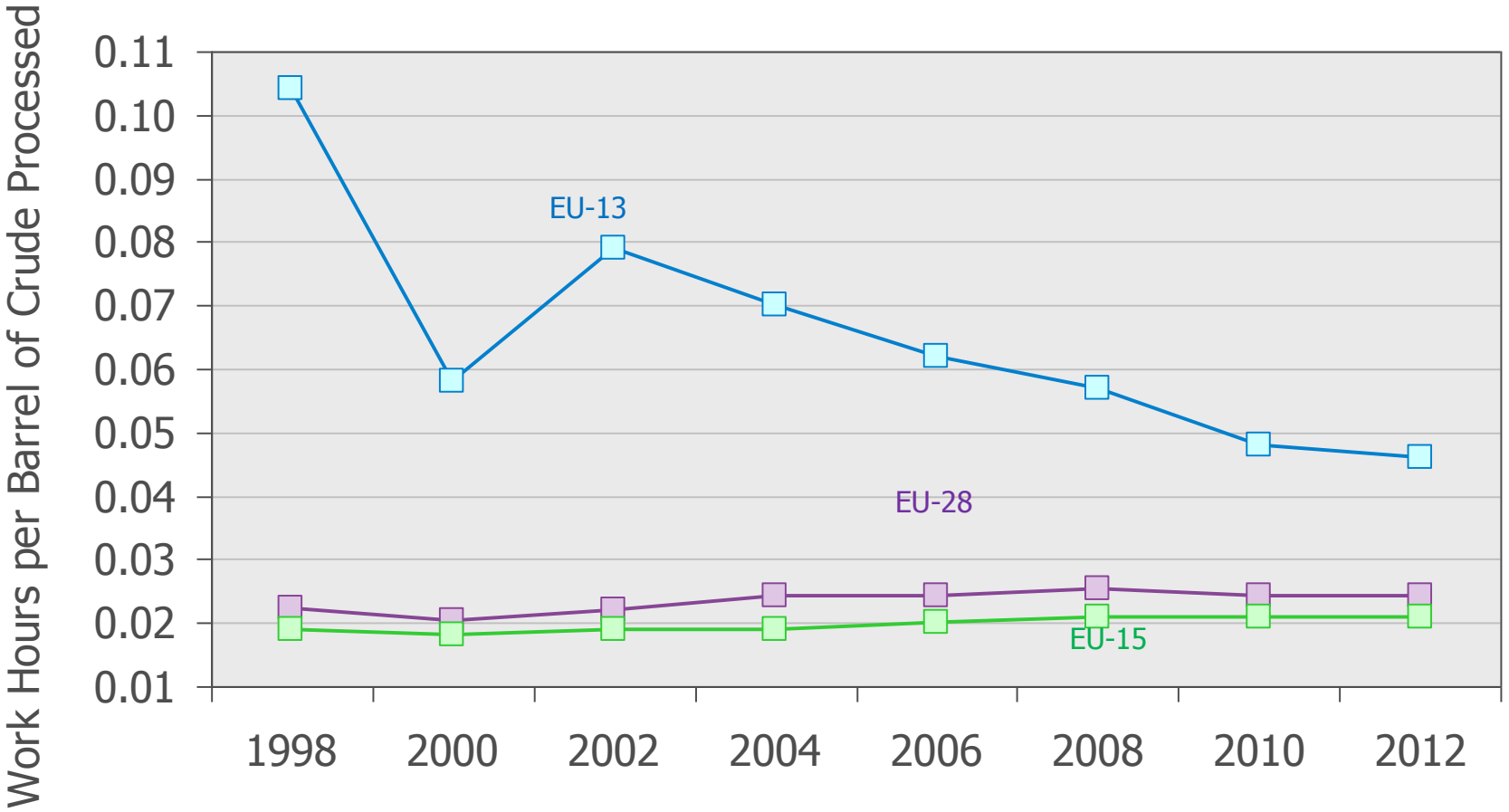
Study Operating Years 1998–2012 (EU-28)



N.B. Not zero on x-axis

Normalised Personnel Hours

Employees + Contractors for Study Operating Years 1998–2012



EU-13 companies are reducing numbers from very high levels.
Benefit from low-wage costs relative to EU-15.

Capital Investment

Thousand Euros per Year (k EUR/yr)

Provided data for study year, prior year, 2 years prior, and 3 years prior

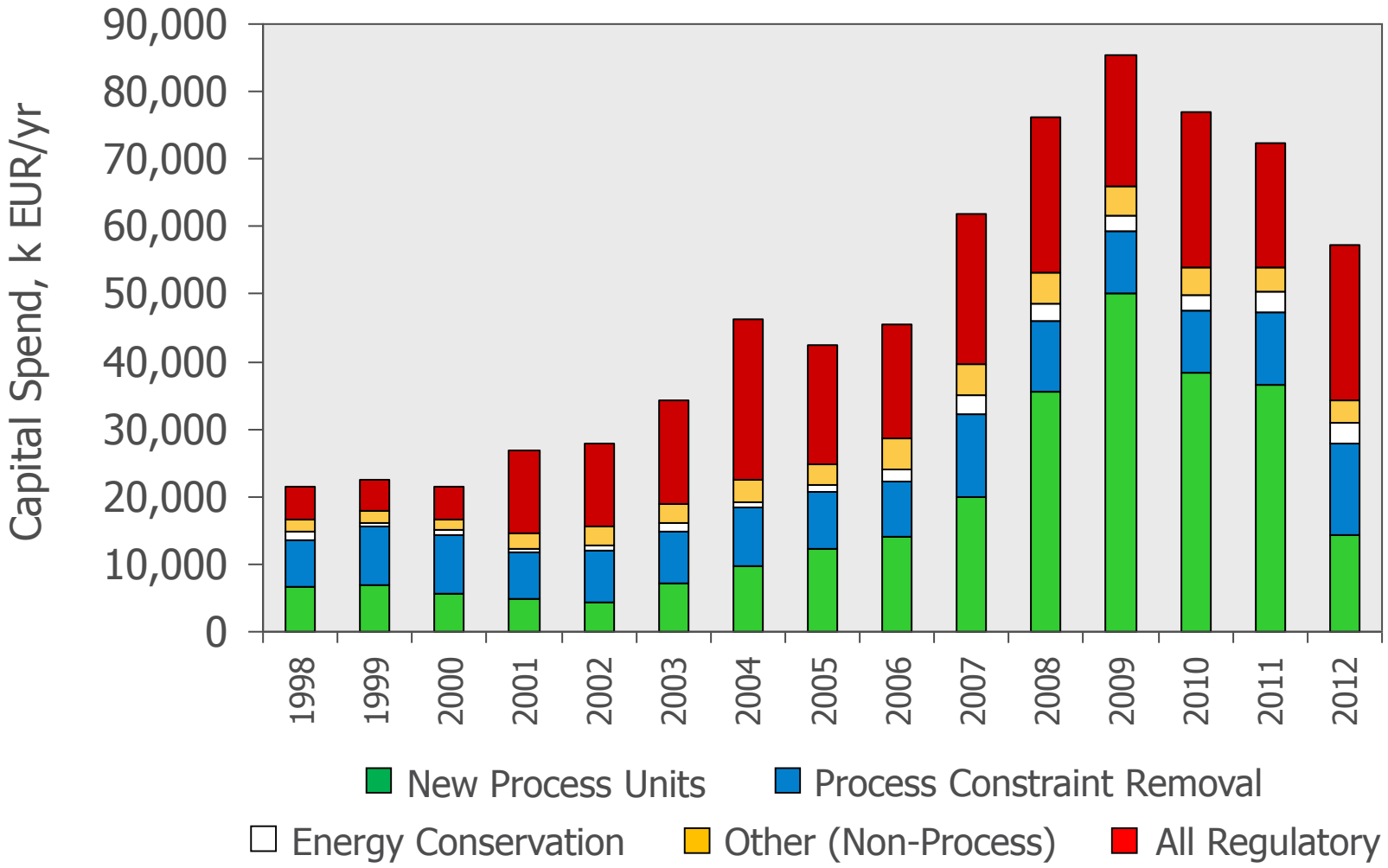
- To smooth out any missing data where refineries did not participate in a study

Categories of investment as follows

- Non-regulatory (profit improvement) investment
  - New units or constraint removal
- Regulatory investment
  - Emissions and effluent
  - New or modified process units for clean fuels
    - Gasoline, diesel, or other
  - Safety
- Energy
- Other non-process

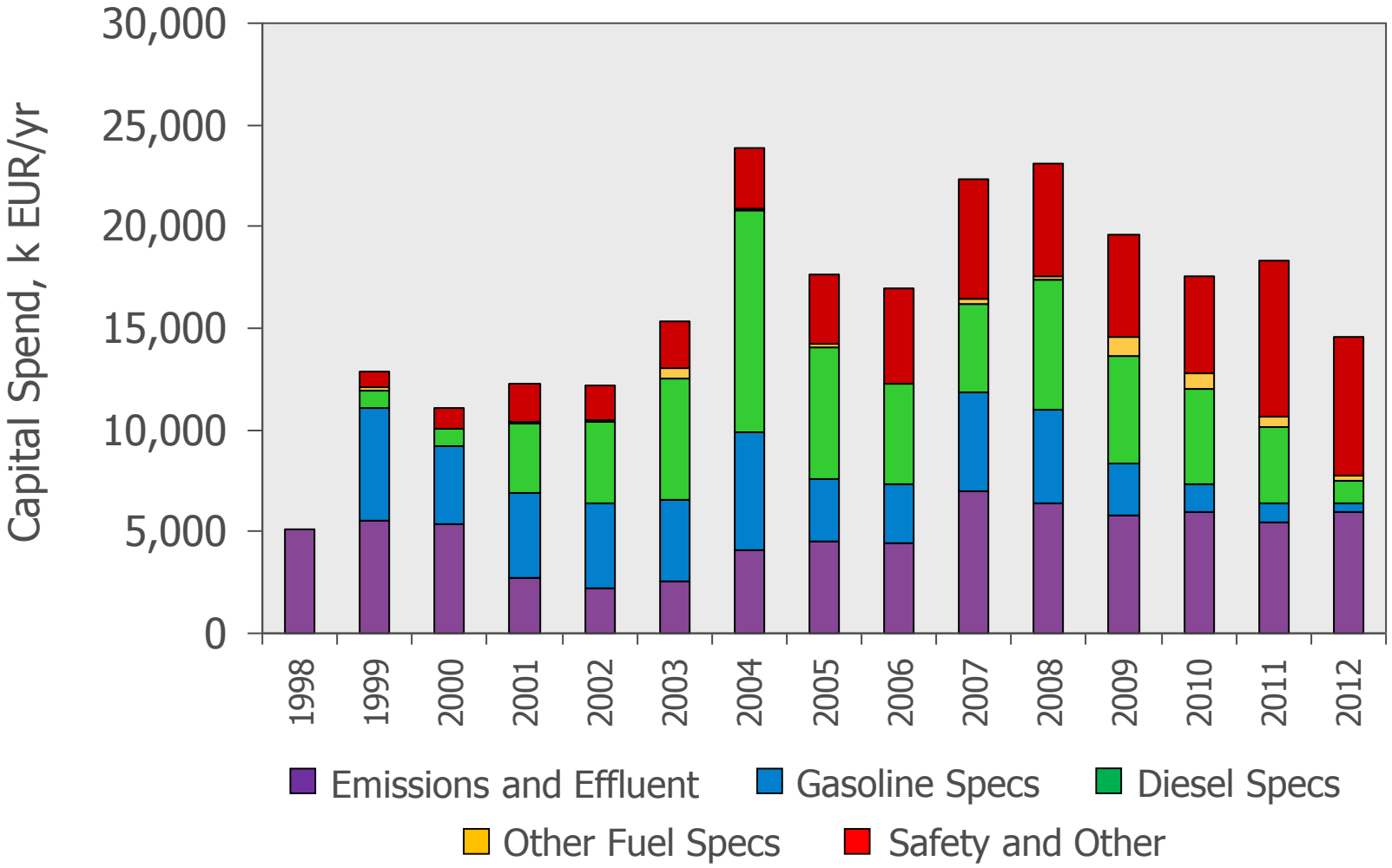
Capital Investment per Refinery

All Operating Years 1998–2012 (EU-28)



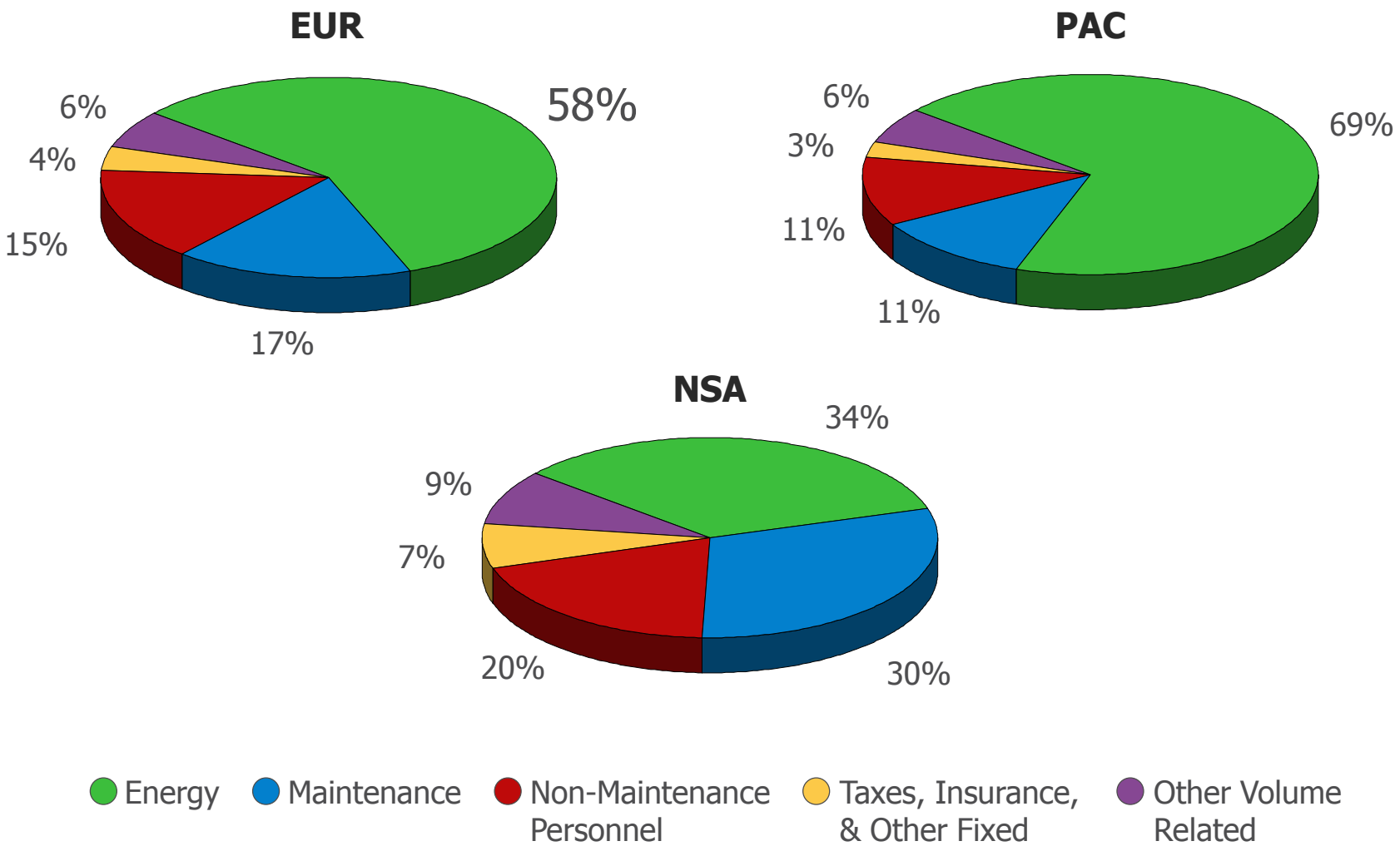
Regulatory Spending Breakdown

All Operating Years 1998–2012 (EU-28)



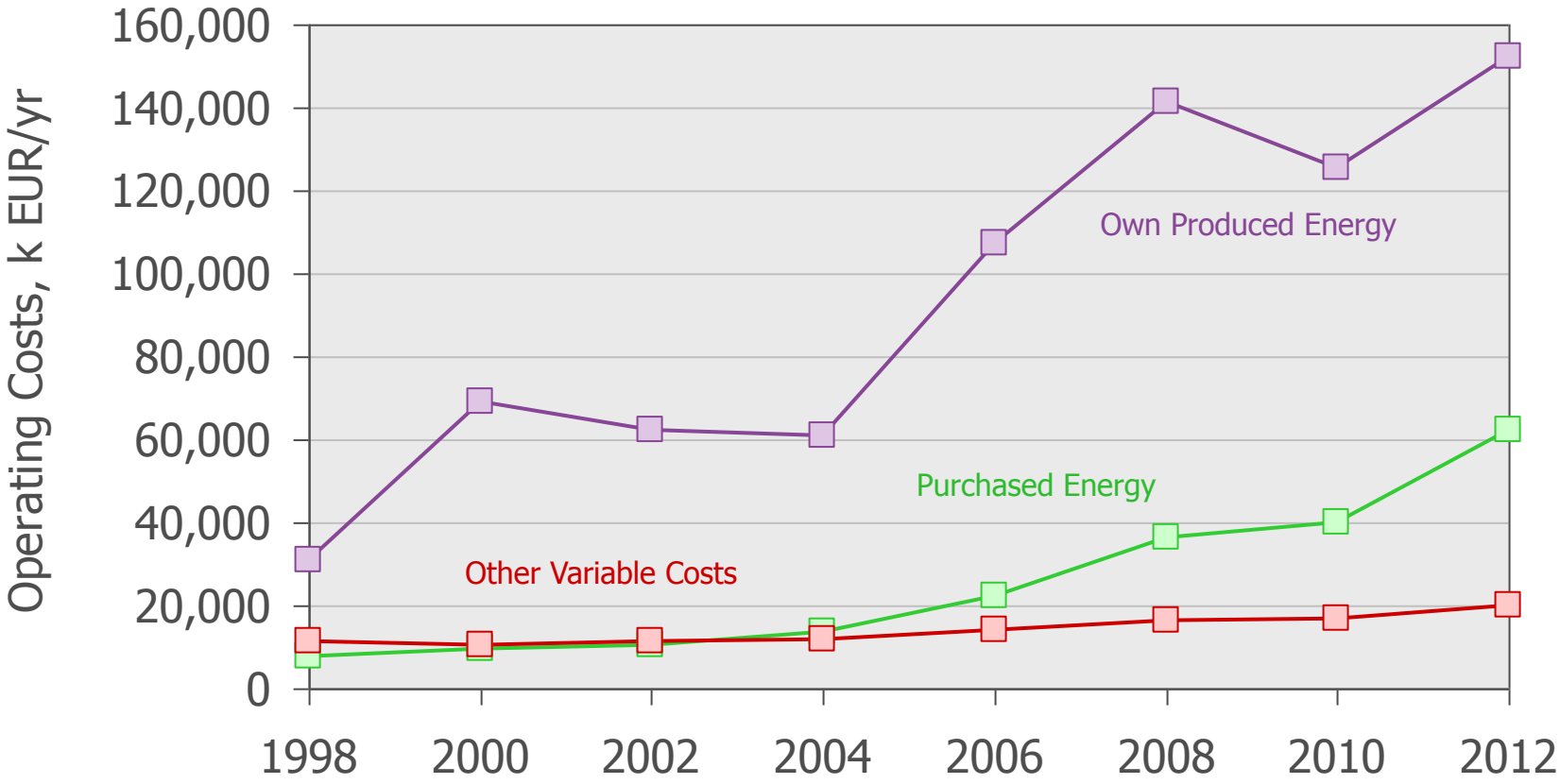
* Data on Fuels specs and Safety Spend not collected prior to 2002

Refinery OpEx Components - 2012



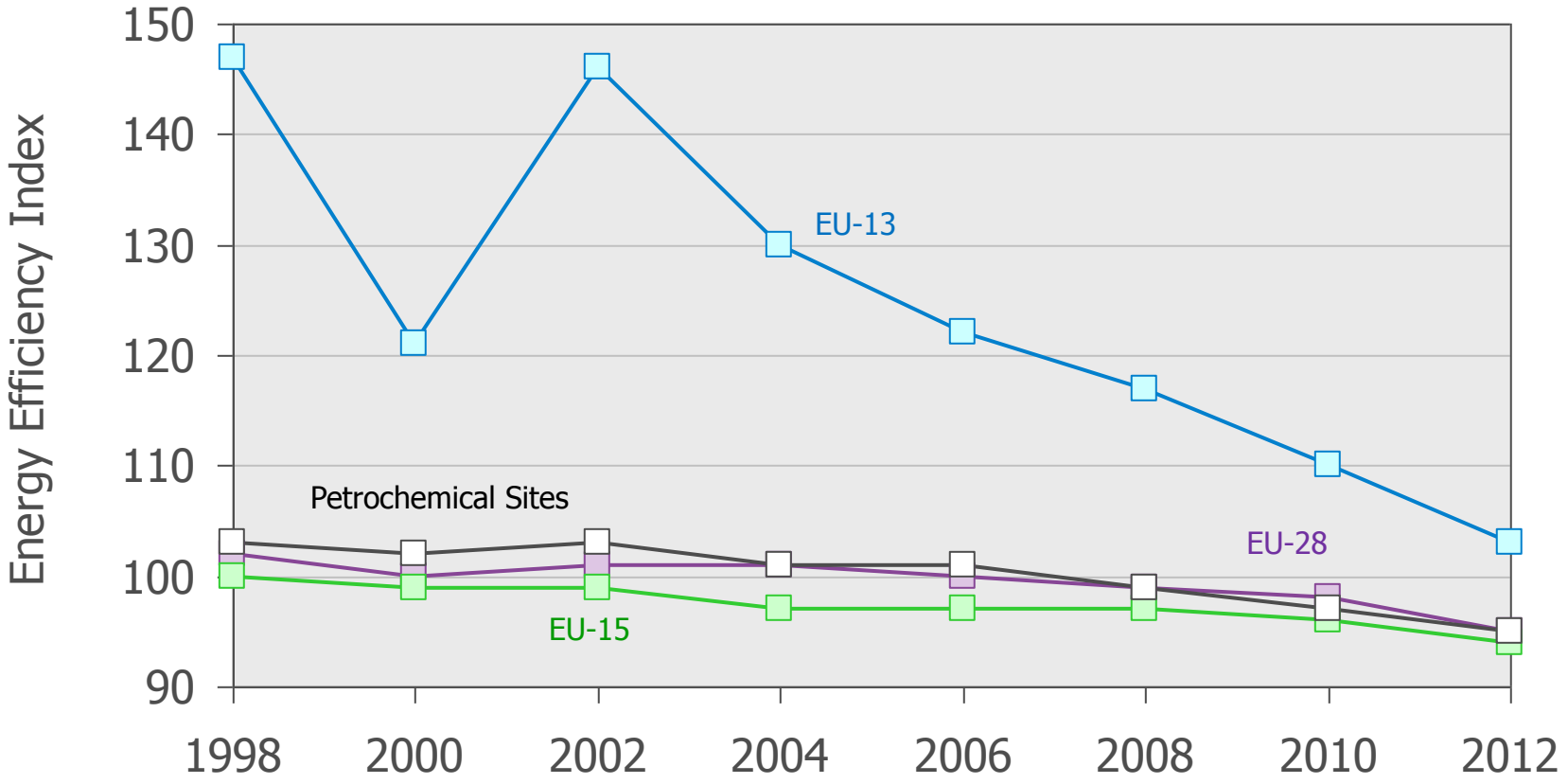
Variable Operating Expenses

Study Operating Years 1998–2012 (EU-28)



Peer Group Energy Efficiency Index

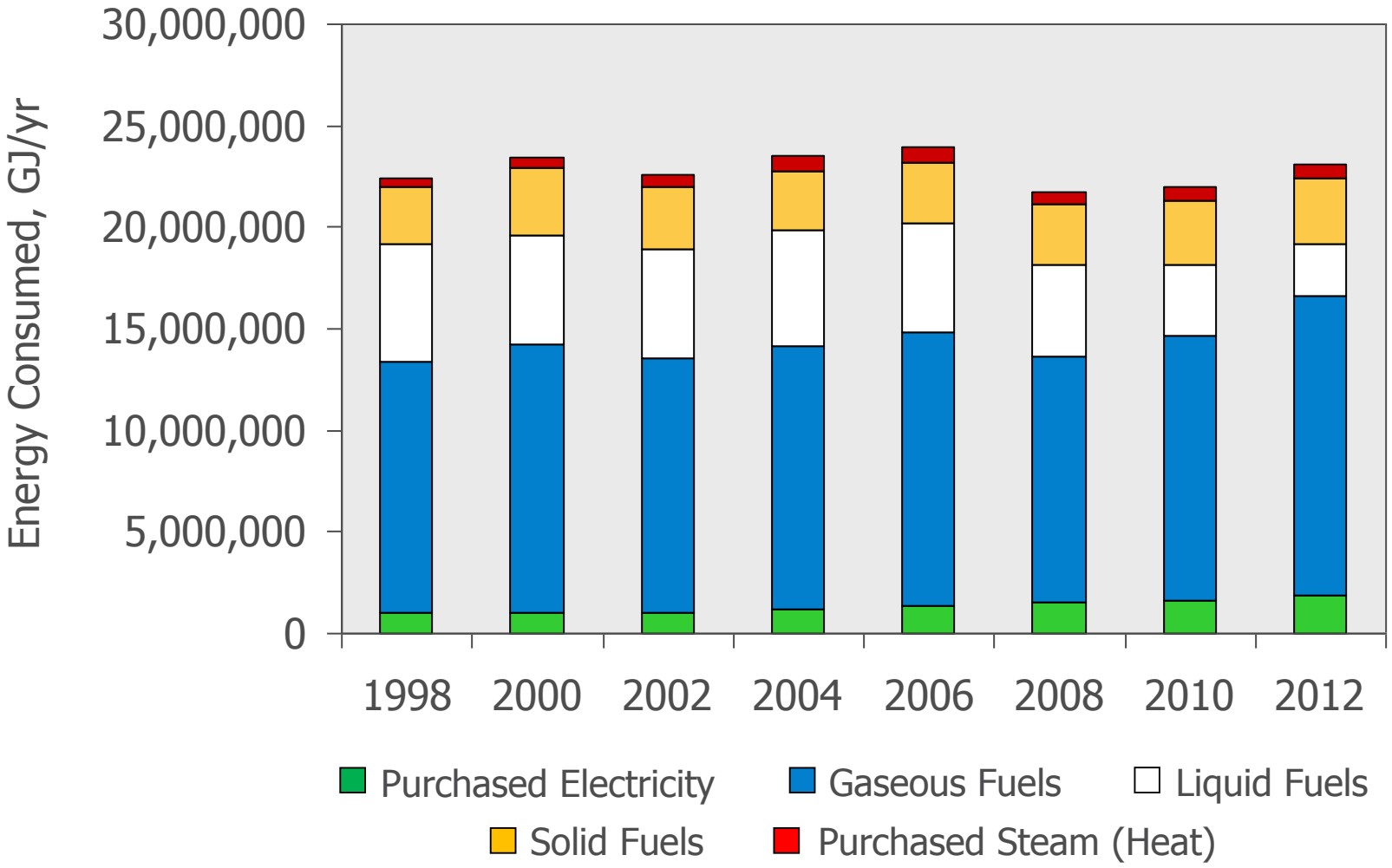
Study Operating Years 1998–2012



Average EII calculation per refinery indexed relative to EU-28 = 100 in year 2000

Refinery Energy Consumed

Study Operating Years 1998–2012 (EU-28)



Fuels Refinery Emissions

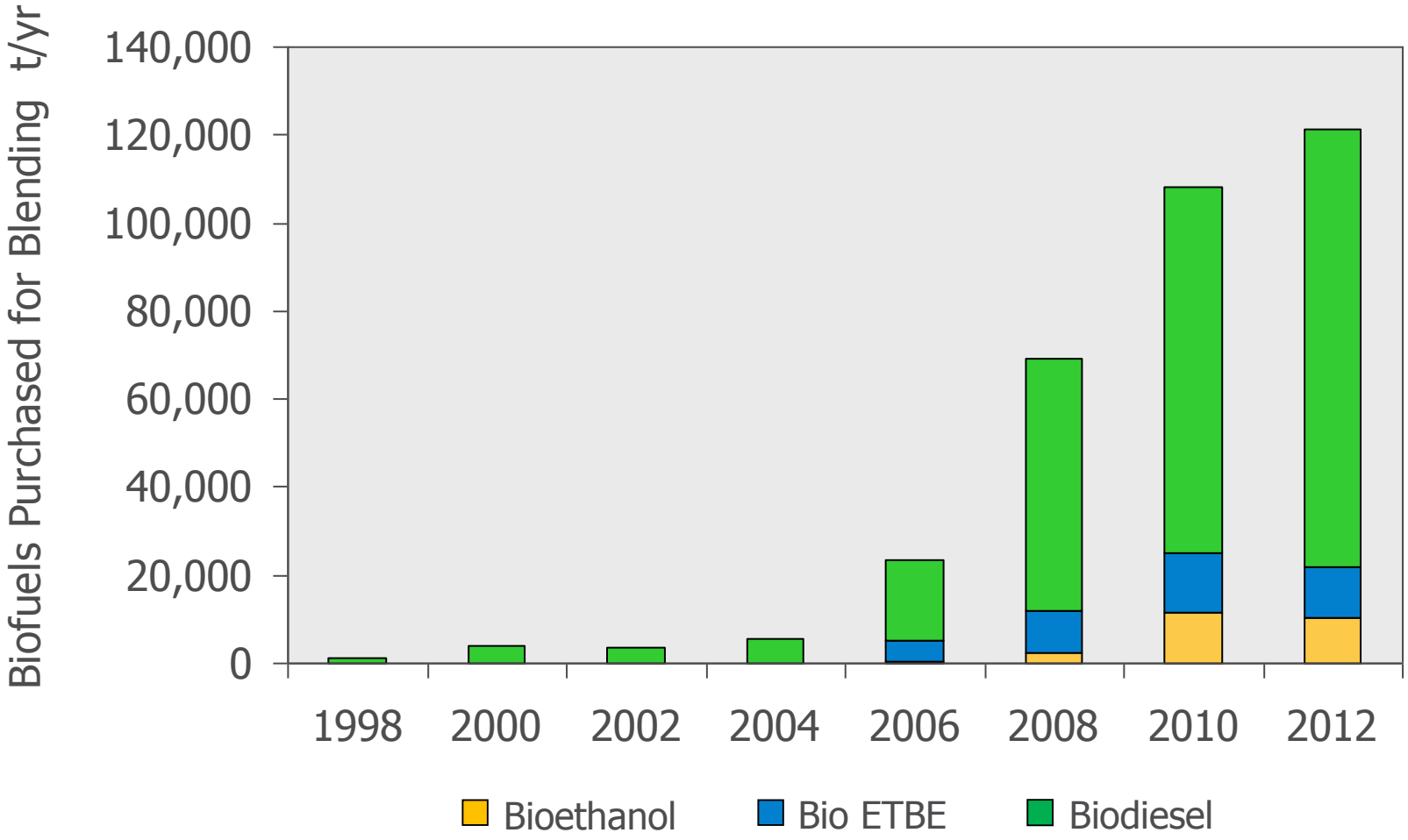
Reported and calculated CO_2 emissions provided

- Calculated equivalent CO_2 emissions from
  - Energy related CO_2 emissions
  - Non-energy CO_2 emissions
  - Carbon equivalent of other emissions
- Actual CO_2 were reported only in 2002 and 2004

NO_X and SO_X data provided since 2004 study

Biofuels for Blending

Study Operating Years 1998–2012 (EU-28)



N.B. ethanol is often blended outside the refinery boundary.

Solomon Associates
M³ — Measure. Manage. Maximize.®

Improving
Competitive Performance
around the world.

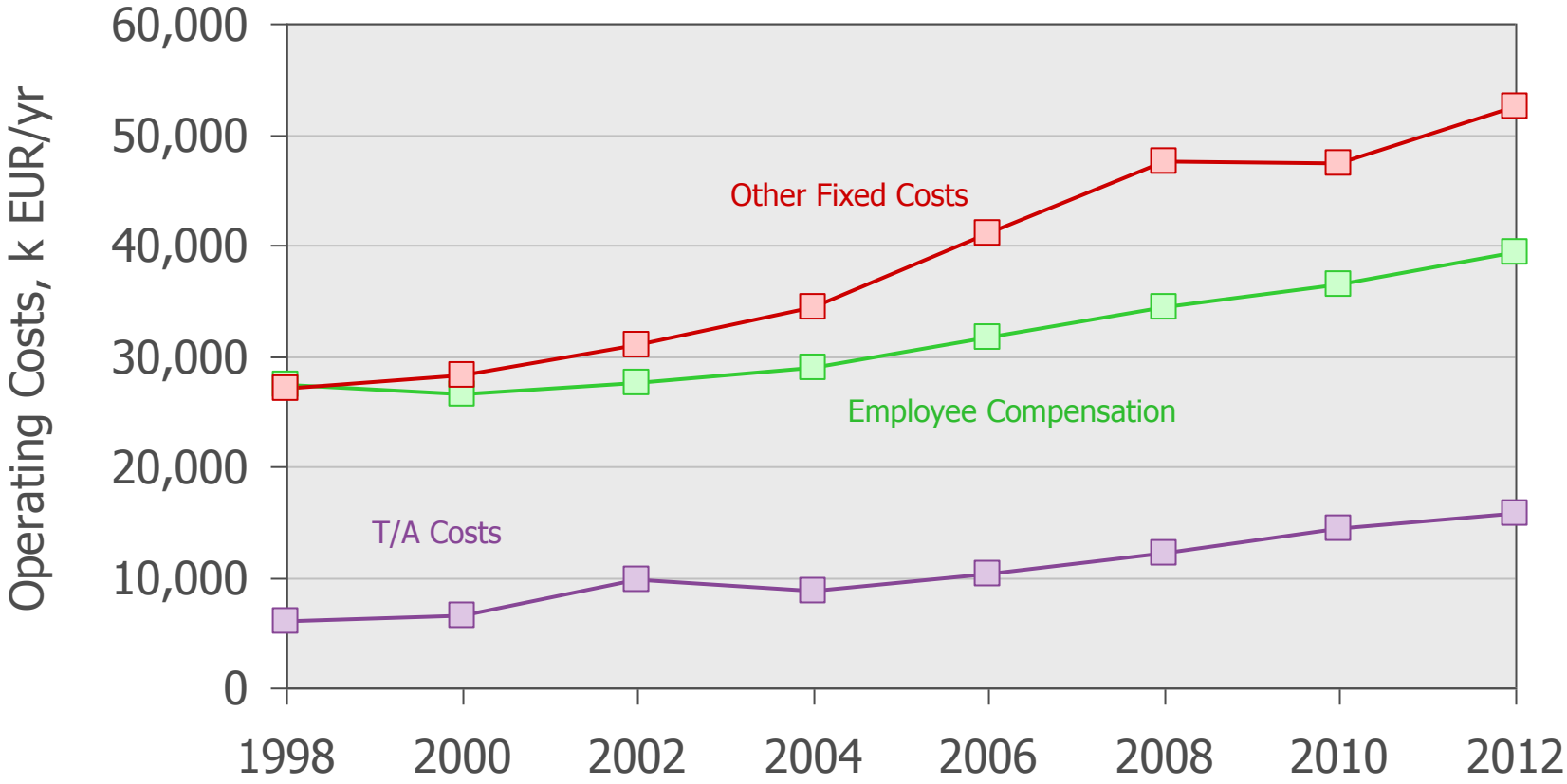
thank you!

Solomon Associates

M³ — Measure. Manage. Maximize.®

Fixed Operating Expenses

Study Operating Years 1998–2012 (EU-28)



Refinery Power Generation

Study Operating Years 1998–2012 (EU-28)