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Understanding Lignite Generation Costs in Europe

Summary

We assessed sizable lignite operations in eight European countries

Overview of Lignite Generation in Europe
(2012)

- Germany
  - 21.5 GW
  - 185.4 Mt
- Poland
  - 9.6 GW
  - 64.3 Mt
- Czech Republic
  - 9.6 GW
  - 43.5 Mt
- Greece
  - 5.2 GW
  - 62.2 Mt

- Serbia
  - 4.0 GW
  - 37.5 Mt
- Romania
  - 4.5 GW
  - 32.1 Mt
- Bulgaria
  - 3.5 GW
  - 30.4 Mt
- Turkey
  - 8.3 GW
  - 70.0 Mt

- *Country*
  - *Installed capacity*
  - *Lignite production*[1)]

1) Including processed products
Source: UDI, Euracoal, Booz & Company Analysis

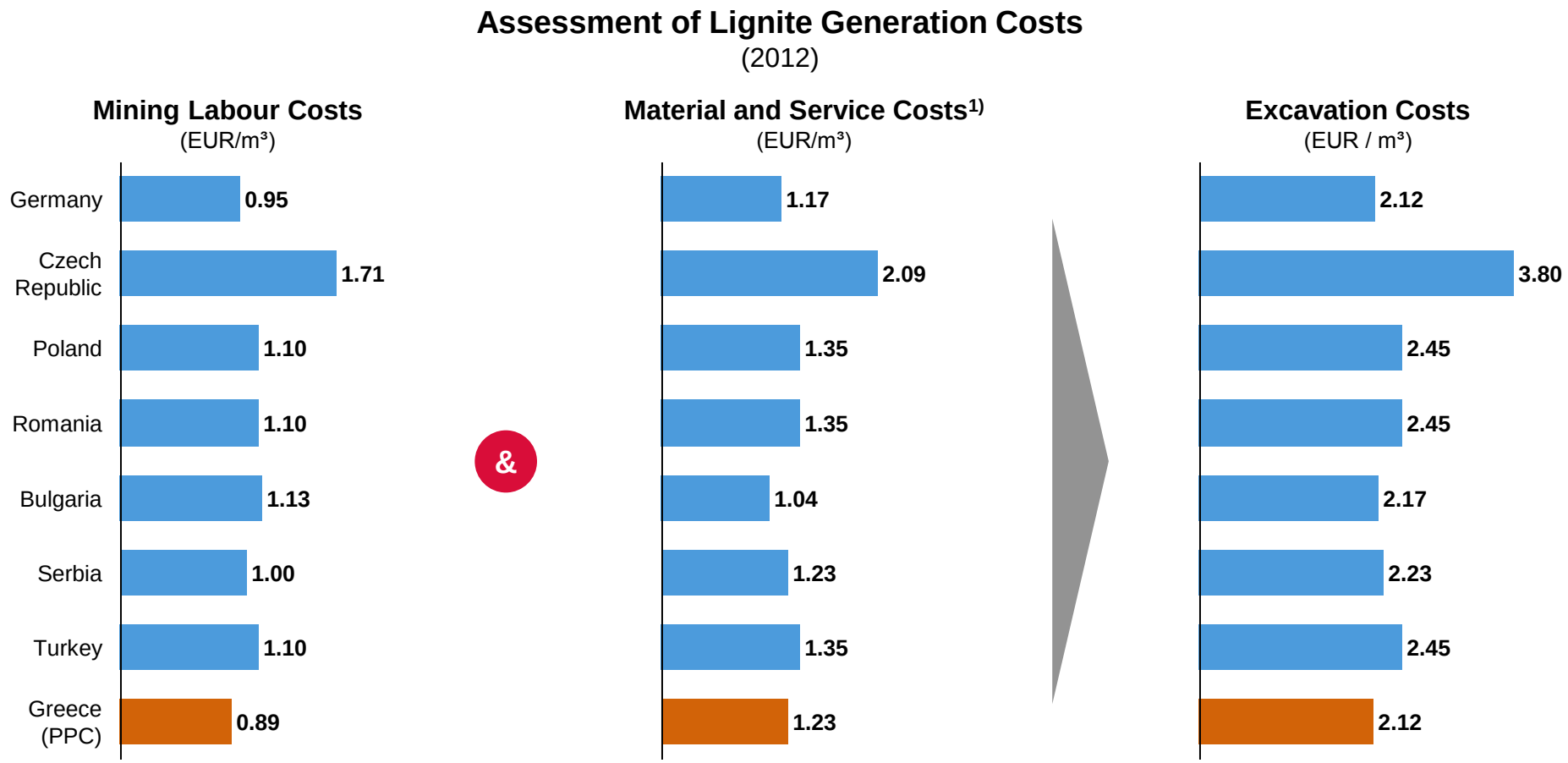
The assessment is based on publicly available data sources using reports of associations and annual reports of relevant companies

Sources of Analysis

Data Source	Implications
▪ Reports on lignite mining of relevant associations for the year 2012 – Euracoal – Market report – Debriv – Lignite in Germany – Eurostat, Statistical Office of Serbia, Turkish Statistical Institute – IEA Statistics – coal information – Stoll, Niemann-Delius, et al – Der Braunkohletagebau ▪ Annual Reports – PPC (Greece) – Vattenfall (Germany) – MIBRAG (Germany) – PGE (Poland) – Severoceske doly (Czech Republic) – EPS (Serbia) – Maritsa Iztok (Bulgaria) – TPP Maritsa East 2 (Bulgaria) – Complexul Energetic Oltenia (Romania) – EÜAS (Turkey) – TKI (Turkey) ▪ Relevant market data – EEX	▪ All analysis can be reproduced based on publically available information ▪ Where possible the assessment is based on data of one key player in the relevant market ▪ Reports of lignite associations and annual reports allow to validate assumptions and orders of magnitude ▪ Some cost drivers such as ash content, water levels, etc. have not been assessed and directly used to estimate costs, however, larger cost differences are included given use of annual reports where possible ▪ Assessment of Greek lignite generation costs is based on publically available PPC data

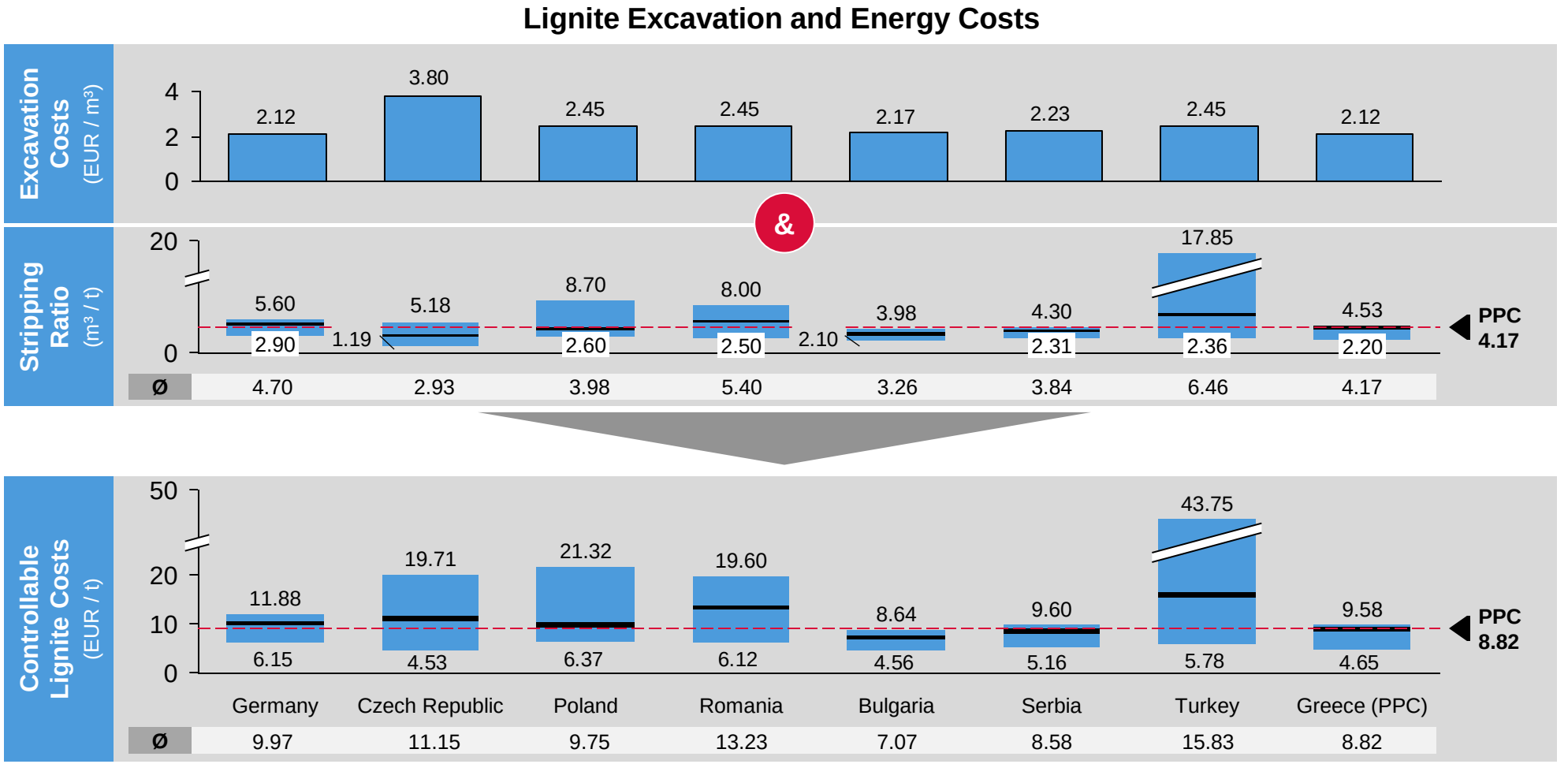
Source: Booz & Company Analysis

Labour as well as material and service costs with similar levels per excavated m³ across all countries



1) Based on annual report data where available
Source: Euracoal, Annual reports, Debriv, Statistical Office of Serbia, Turkish Statistical Institute, Niemann-Delius et al, Achlada, M.E.T.E, PPC, Booz & Company Analysis

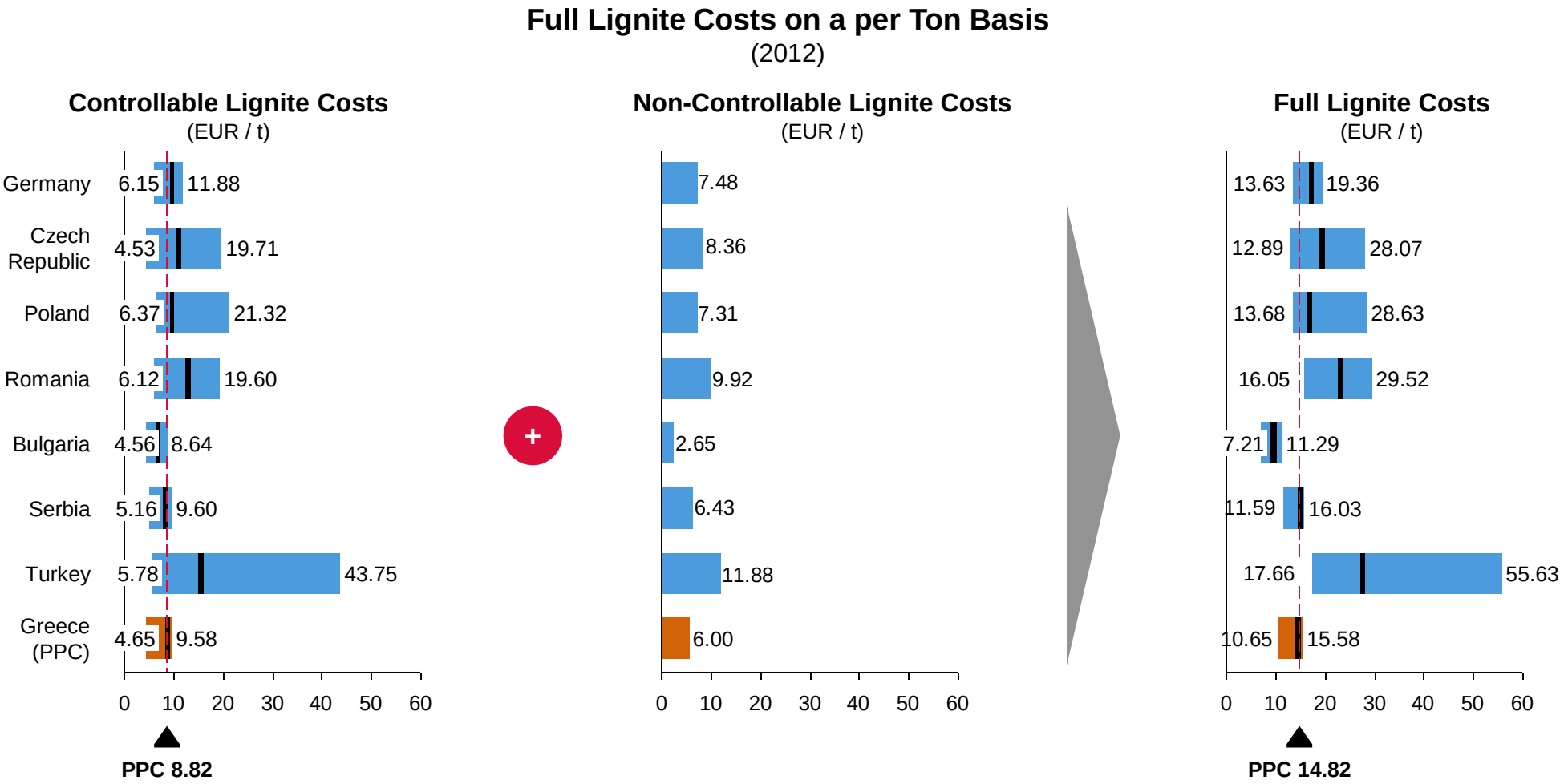
PPC with average cost per ton of lignite given average stripping ratio and excavation costs



Note: Lignite sources with stripping ratio above 15 m³/t will most likely be a theoretical resource, but not be mined in reality

Source: Euracoal, Annual reports, Debriv, Statistical Office of Serbia, Turkish Statistical Institute, Niemann-Delius et al, Achlada, M.E.T.E, PPC, Booz & Company Analysis

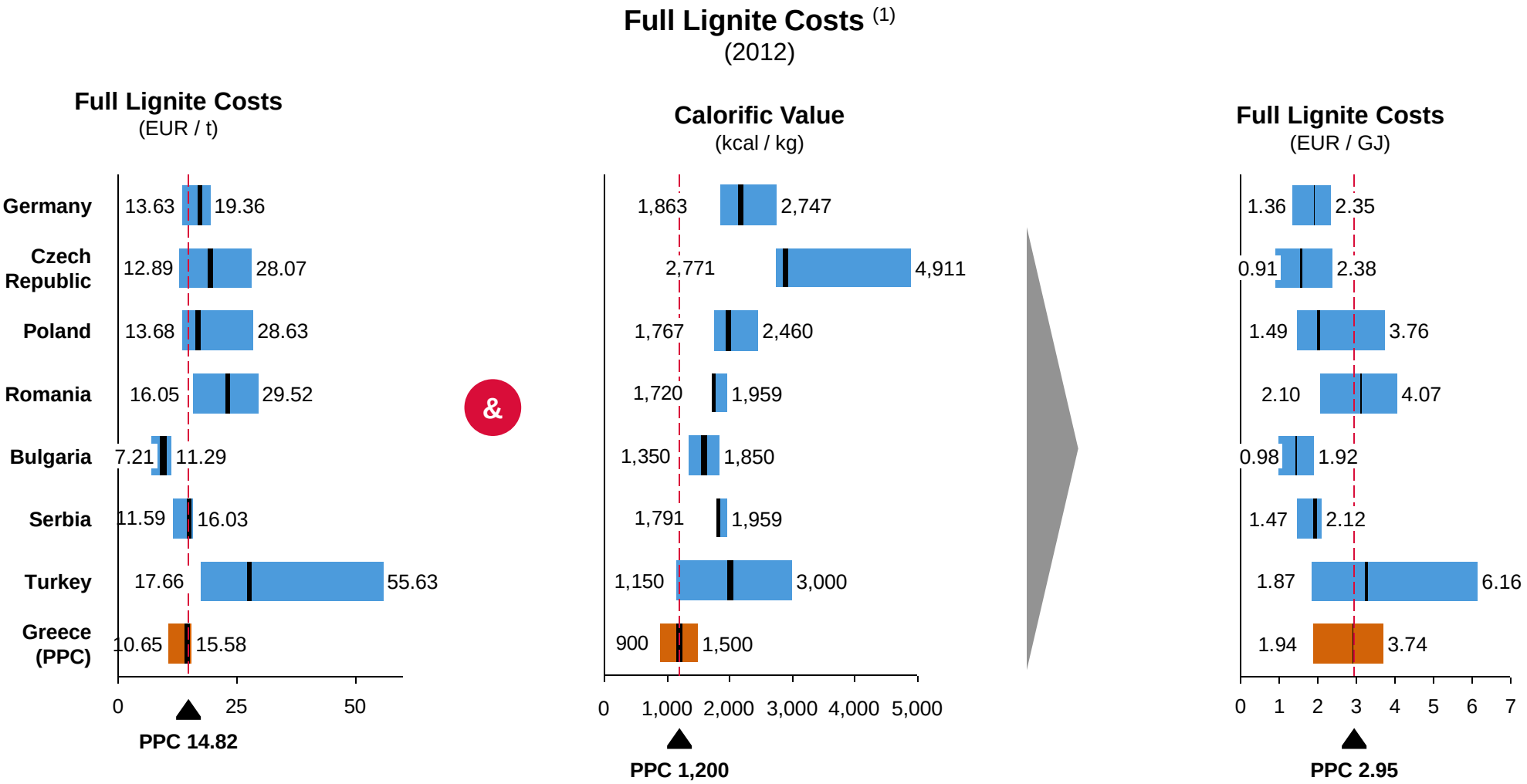
Adding non-controllable costs keeps PPC in the same relative position compared to the other European systems



1) FTE in lignite mining according to Euracoal deducted by FTE in Achlada mine and M.E.T.E mine

Source: Euracoal, IEA, Eurostat, Annual reports, Debriv, Statistical Office of Serbia, Turkish Statistical Institute, Niemann-Delius et al, Achlada, M.E.T.E, PPC, Booz & Company Analysis

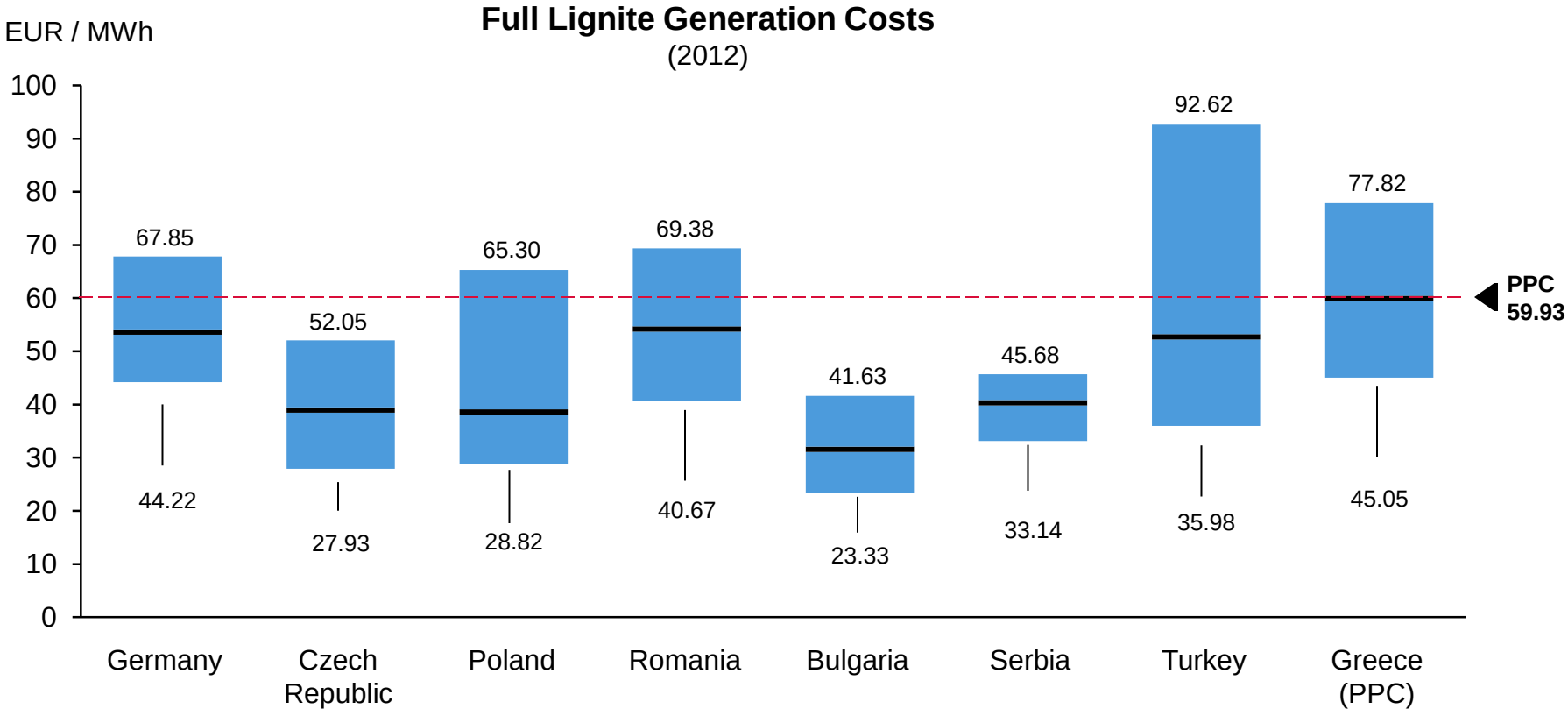
Combining lignite per ton costs with calorific value leads to highly different full lignite costs per GJ



1) Including depreciation and cost of capital

Source: Euracoal, IEA, Eurostat, Annual reports, Debriv, Statistical Office of Serbia, Turkish Statistical Institute, Niemann-Delius et al, Achlada, M.E.T.E, PPC, Booz & Company Analysis

Lignite generation costs differ substantially across Europe with Greece exhibiting the highest cost of around 60 EUR/MWh, mainly due to structural differences (calorific value of lignite)

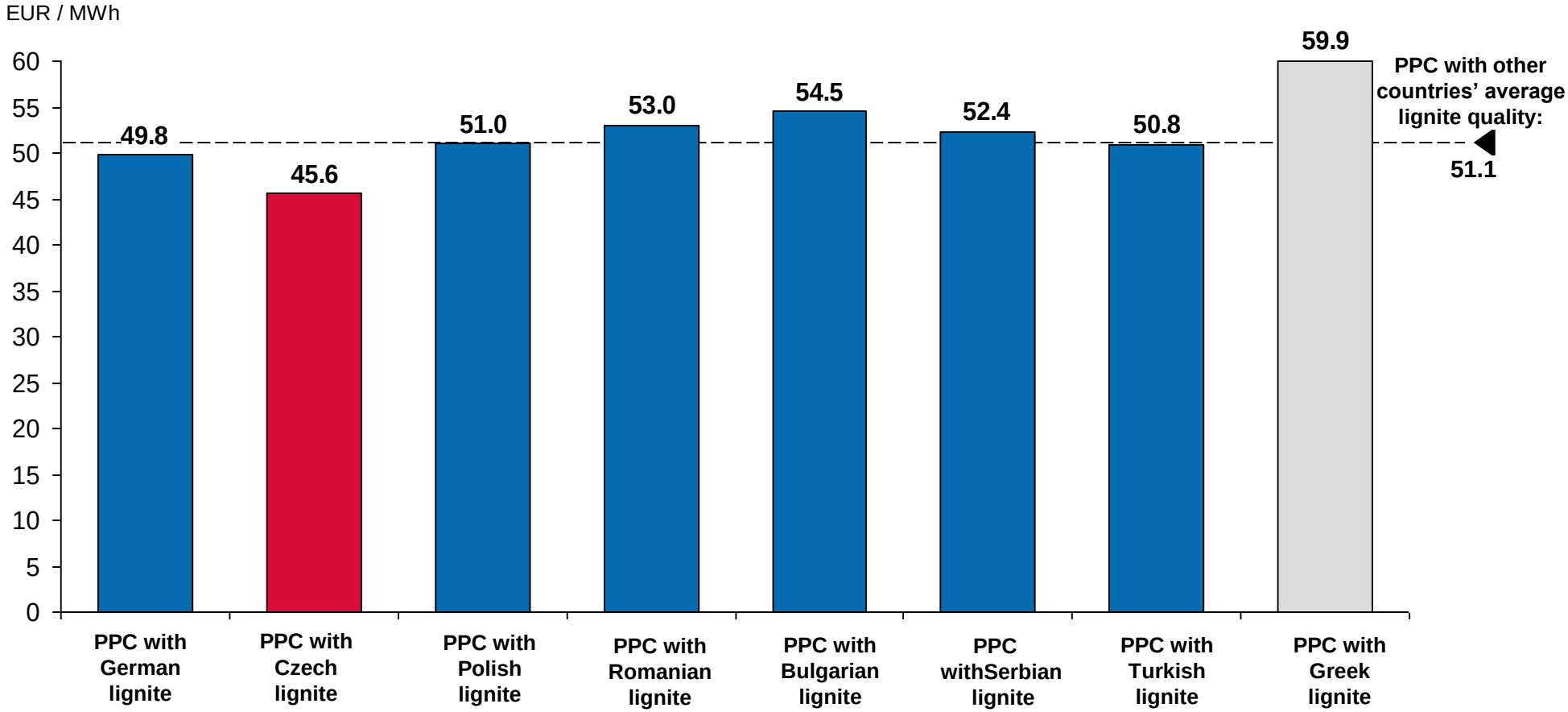


	Germany	Czech Republic	Poland	Romania	Bulgaria	Serbia	Turkey	Greece (PPC)
System Average (EUR / MWh)	53.60	38.97	38.60	54.19	31.57	40.32	52.73	59.93

Source: Euracoal, IEA, EEX, Eurostat, Annual reports, Debriv, UDI, Statistical Office of Serbia, Turkish Statistical Institute, Niemann-Delius et al, Achlada, M.E.T.E, PPC, Booz & Company Analysis

Eliminating structural differences (calorific value) show what Greek lignite generation cost could be

Hypothetical Cost of Lignite Generation in Greece Changing Calorific Value of Greek lignite to match the Calorific Value of lignite in other countries



Source: Euracoal, IEA, EEX, Eurostat, Annual reports, Debriv, UDI, Statistical Office of Serbia, Turkish Statistical Institute, Niemann-Delius et al, Achlada, M.E.T.E, PPC, Booz & Company Analysis