Trace Metal Content of Lignite Coal from Western Balkans Exacerbates Air-Pollution-Related-Health Risk

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Introduction

- The region heavily depends on lignite coal for electricity and household heating, which poses serious threats to the environment and public health

  - Financing new electricity systems could significantly impact exposure pathways for trace metals in coal
  - Combustion processes and particulate matter pose public health concern[1]
- Lack of consideration of these metals leads to incomplete estimation of external costs to pollution[2]

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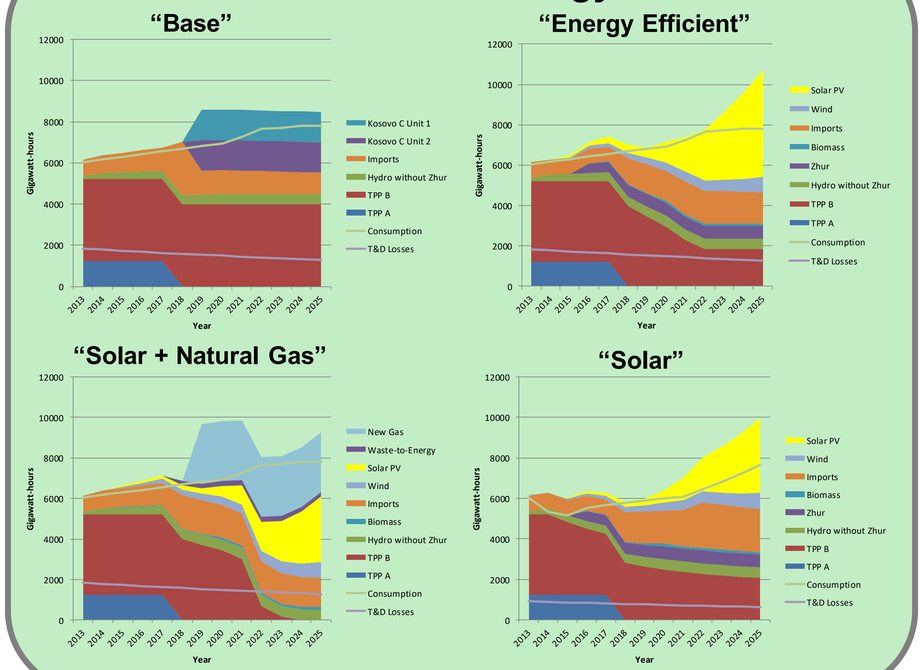
2. Finkelman, R. M.; Gross, P. M. The types of data needed for assessing the environmental and human health impacts of coal. *Int. J. Coal Geol.* **1999**, *40* (2-3), 91-101 DOI: 10.1016/S0166-5162(98)00061-5.

Future Renewable Energy Solutions



Methodology

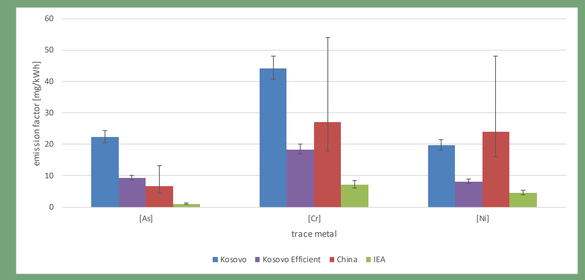
Obtain 50 gram samples of Pliocene lignite coal for inductively coupled plasma mass spectrometry analysis of trace metal concentrations (EPA Protocol 6020 and 7471A)

Create spreadsheet model to determine trace metal impact normalized per kWh of final electricity delivered and compare to reported valued in literature

Determine occupational and air pollution-related risk using European Commission's ExternE program for 4 scenarios (base, natural gas + solar, energy efficient, and solar)

Results

Heavy Metal	Content in Balkan Coal	International Energy Agency Global Average	Content in coals from China[38,39]		Content in coals from USA[37]		Content in coals around the world[37]
			Bai et al. (2007)	Dai et al. (2012)	Arithmetic mean	Geometric mean	
Arsenic	9.6 ± 1.6	2.69	4.09	3.79	24	6.5	8.3
Chromium	19 ± 1.7	17.6	16.94	15.4	15	10	16
Mercury	0.035 ± 0.020	0.091	0.154	0.163	0.17	0.10	0.10
Nickel	8.5 ± 1.7	11.1	14.44	13.7	14	9	13



	Air pollution-related risk		
Energy Scenario	Deaths	Serious Illness	Minor Illness
Base	2,100 (520-8,200)	19,000 (4,700-57,000)	1,100,000 (280,00-4,500,000)
Energy Efficient	1,900 (480-7,500)	17,000 (4,300-69,000)	1,000,000 (250,000-4,100,000)
Solar	1,800 (460-7,200)	17,000 (4,200-66,000)	980,000 (250,000-3,900,000)
Solar + Natural Gas	1,300 (330-5,100)	12,000 (3,000-48,000)	680,000 (170,000-2,700,000)

Discussion and Recommendations

- Arsenic and chromium concentrations in pre-combusted coal exceed IEA averages and are of special concern; presence of all metals poses harmful human and environmental health impacts
- Improving grid efficiency not enough to significantly reduce exposure to toxic heavy metals—need to completely and quickly phase out coal use for energy generation
- "Solar + Natural Gas" path provides best public health outcomes by mitigating risk from coal
- Reappraisal of financing options by multi-lateral development banks and more comprehensive risk assessment to include analysis of heavy metals and composition of particulate matter

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