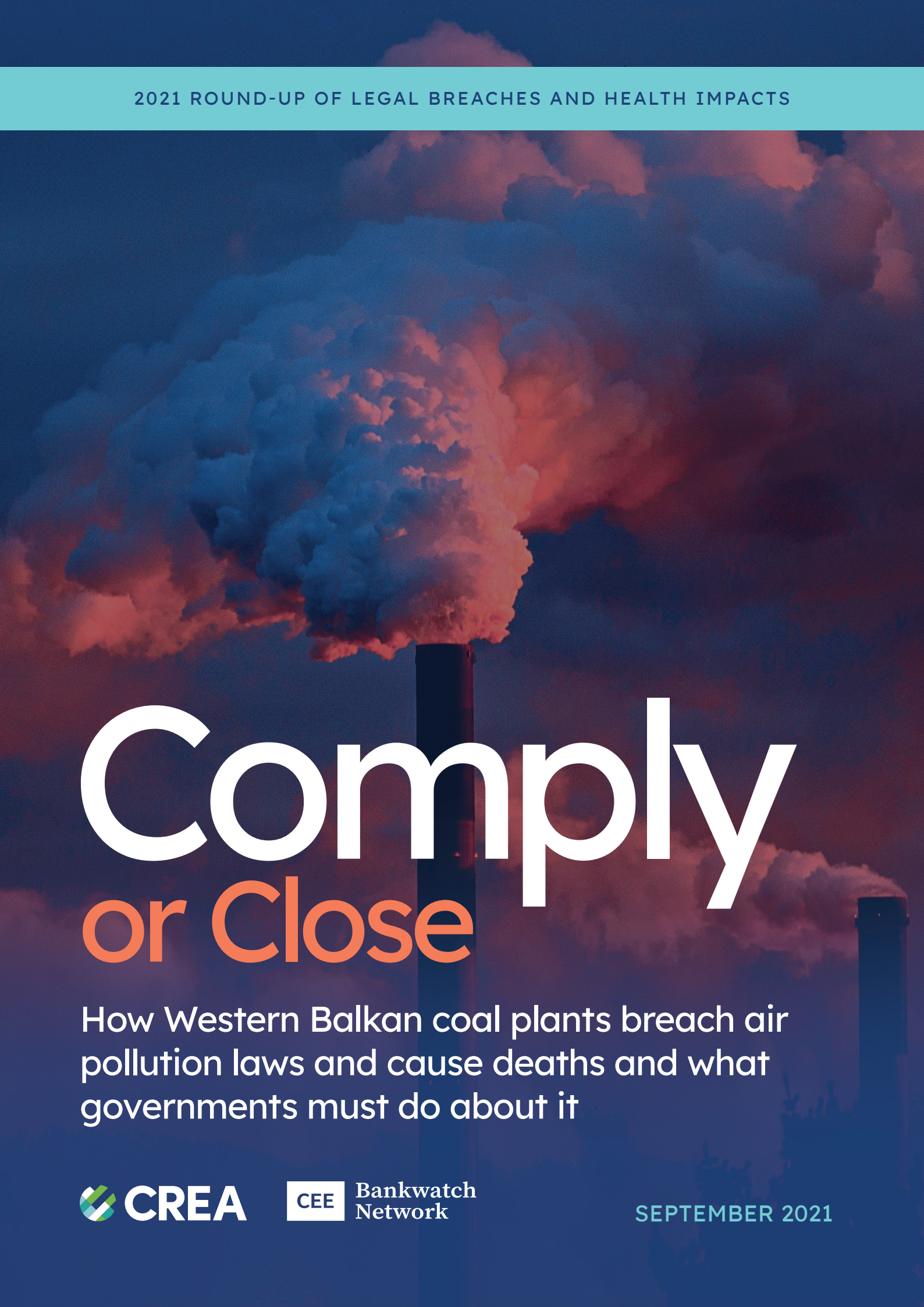
2021 ROUND-UP OF LEGAL BREACHES AND HEALTH IMPACTS



Comply or Close

How Western Balkan coal plants breach air pollution laws and cause deaths and what governments must do about it

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Glossary

De-NO_x – Equipment for the reduction of nitrogen oxides emissions

De-SO_x – Desulphurisation equipment

ELV – Emission limit value. This represents the permissible quantity of a substance contained in the waste gases from the combustion plant which may be discharged into the air during a given period; it is calculated in terms of mass per volume of the waste gases expressed in mg/Nm^3.

Energy Community Treaty – A Treaty signed in 2005 that entered force in 2006 and aims to extend the EU energy market to its nearest neighbours, by applying EU energy, environment and competition legislation to their energy sectors. The Treaty currently includes the European Union, Albania, Bosnia and Herzegovina, Georgia, Kosovo, Moldova, Montenegro, North Macedonia, Serbia and Ukraine.

EU – European Union

IED – Industrial Emissions Directive – Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).

LCP – Large combustion plant. This is defined as a technical apparatus which is used to oxidize fuel in order to use the heat generated with a rated thermal input of equal to or greater than 50 megawatts (MW). This includes plants such as fossil fuel or biomass-fired power stations and combustion in petroleum refineries.

LCP BREF – Best Available Techniques Reference Document for Large Combustion Plants, the conclusions of which were made legally binding in Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants (notified under document C(2017) 5225.

LCPD – Large Combustion Plants Directive – Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants.

MWe – Megawatts of electric power – the most common form of expression of a power plant's capacity.

MWth – Total rated thermal input of a power plant – the rating used in EU legislation to define different size categories of power plants. In general, it is harder to achieve lower emissions concentrations from smaller power plants, so pollution limits are differentiated by size.

NERP – National Emissions Reduction Plan – a flexible implementation mechanism under the Large Combustion Plants Directive in the Energy Community whereby emissions can gradually be reduced by totalling their combined emissions and ensuring they are lower than the decreasing ceilings set for 2018, 2023, 2026 and 2027.

NO_x – Nitrogen oxides

Opt-out – A flexible implementation mechanism under the Large Combustion Plants Directive whereby plants can delay investments in pollution control equipment as long as they limit their operating hours to 20,000 between 1 January 2018 and 31 December 2023. Any plants operating after that have to comply with the rules for emissions from new plants, not existing ones.

PM or **dust** – Suspended particulate matter or dust particles.

SO_2 – Sulphur Dioxide

Executive summary

For the past three years, new air pollution standards should have brought reductions in harmful emissions from coal plants across the Western Balkans. But in 2020, sulphur dioxide emissions from coal power plants across the region still flagrantly breached these legal limits.

A drop in emissions might have been expected in 2020 due to the reduction of economic activity as a result of the COVID-19 pandemic. But this was far from the case. For the plants included in the National Emissions Reduction Plans (NERPs)[1] of Bosnia and Herzegovina, Kosovo, North Macedonia and Serbia, emissions *increased*, rather than decreased.

In 2018 and 2019, coal plants that were included in the NERPs emitted around six times as much sulphur dioxide (SO_2) as allowed, but in 2020 they emitted 6.4 times as much. The plants emitted around 1.6 times as much dust as allowed in all three years between 2018 and 2020, and absolute emissions even increased slightly.

Moreover, in 2020 the total SO_2 emissions from coal-fired power plants in the Western Balkans were 2.5 times as high as those from all coal plants in the EU.

Only nitrogen oxides (NO_x) emissions were still below the sum of the countries' ceilings for 2020 – 0.9 times as much as allowed. However, Bosnia and Herzegovina and Kosovo breached their national ceilings, and regionally, nitrogen oxides emissions have slightly increased. The pollution limits for NO_x continue to decrease annually, so more breaches are likely in the coming years unless swift action is taken.

Moreover, health modelling shows that nearly 19,000 deaths occurred from 2018 to 2020 due to the total emissions of coal-fired power plants in the Western Balkans. Of these, more than 50 per cent (10,800) were in EU countries, almost 30 per cent (6,500) in the Western Balkans and the remainder in countries further afield. The total emissions of coal power plants resulted in costs between EUR 25.3 billion and 51.8 billion.

The total number of deaths from 2018 to 2020 caused only by Western Balkan coal power plants' exceedances of the NERP ceilings was nearly 12,000 (11,660). More than half of these occurred in EU countries, with 7,000 deaths of EU residents, 3,700 deaths in the Western Balkans, and 960 in other regions further afield.

Overall, health costs of between EUR 6.0 billion and 12.1 billion are estimated to have been incurred in 2020 due to the emissions exceedances alone from the Western Balkans' coal plants.

Close to three quarters of these costs (73 per cent) relate to people and countries in the EU (EUR 4.4 to 8.9 billion), 21 per cent (EUR 1.3 to 2.6 billion) to Western Balkan countries and the remaining 6 per cent to other countries (EUR 0.3 to 0.7 billion). The costs are borne both at the individual and national levels; through personal costs for medical treatment, increased national healthcare budgets and reduced productivity (which exacerbates the economic impact).

Due to the breaches of the NERP pollution limits in 2018 and 2019, in March 2021 the Energy Community Secretariat opened dispute settlement cases against Bosnia and Herzegovina, Kosovo, North Macedonia and Serbia.[2]

Montenegro, although it does not have a NERP because it has only one coal plant, also became non-compliant with the Large Combustion Plants Directive in 2020. The Pljevlja coal power plant used up the 20,000 hours that the opt-out regime allowed it to operate after 1 January 2018 and continues to operate. The Energy Community Secretariat therefore opened a dispute settlement case against Montenegro in April 2021.[3]

[1] *As part of their obligations to comply with the Large Combustion Plants Directive under the Energy Community Treaty, four Western Balkan countries – Bosnia and Herzegovina, Kosovo, North Macedonia and Serbia – have drawn up National Emission Reduction Plans (NERPs) covering the period from 2018 to 2027. Instead of requiring each large combustion plant to comply with the emission limit values from the Large Combustion Plants Directive from 1 January 2018, these plans allow the countries to calculate national emissions ceilings for sulphur dioxide, nitrogen oxides and dust, and to gradually decrease their total emissions from selected pre-1992 large combustion plants until 2027. In 2027, all the plants included in the NERPs will individually need to be in compliance not only with the emission limit values from the Large Combustion Plants Directive, but also with Part 1 of Annex V to Directive 2010/75/EU on Industrial Emissions.*

[2] *Energy Community Secretariat, Secretariat initiates dispute settlement procedures against four Contracting Parties in relation to NERPs, 16 March 2021.*

[3] *Energy Community Secretariat, Secretariat launches dispute settlement procedure against Montenegro for breaching Large Combustion Plants Directive as TPP Pljevlja exhausts 'opt-out', 20 April 2021.*

Gacko power plant, Bosnia and Herzegovina
Photo credit: Center for Environment

In 2020, Serbia's NERP plants were the highest SO_2 emitters, with 333,602 tonnes, followed by Bosnia and Herzegovina with 220,411 tonnes. The SO_2 emissions from Serbia's coal power plants overtook those from all 221 plants in the entire European Union in 2020.

In absolute terms, Ugljevik in Bosnia and Herzegovina was once again the highest-emitting unit for SO_2 in the region in 2020, with 107,402 tonnes. Yet the sum of all four countries' limits for SO_2 was 103,682 tonnes, meaning that this one plant alone breached all their ceilings put together.

Kakanj 7 in Bosnia and Herzegovina was the worst offender in breaching its individual ceiling for SO_2 in 2020, emitting almost 15 times as much as allowed. Ugljevik and Serbia's Kostolac B1 and B2 both emitted almost 12 times as much as allowed, despite having desulphurisation equipment fitted.

The EU is a net importer of electricity,[4] including from the Western Balkans. Thus, it bears not only much of the health costs of coal power generation in the region, but also some of the responsibility. From 2018 to 2020 the Western Balkans exported 25 TWh of electricity into the EU, amounting to 8 per cent of the total coal-fired power generation in the Western Balkans. Hence, the EU plays a significant role in sustaining coal-based electricity in the region.

[4] *European Commission, Electricity and heat statistics, Eurostat, 2020.*

The EU's imports of electricity from the Western Balkans make up only 0.3 per cent of the EU's total electricity consumption, but the SO_2 emissions associated with these imports equal 50 per cent of the entire SO_2 emissions from all power plants in the EU in 2020.

This is because power generation in the Western Balkans is around 300 times more SO_2-intensive than in the EU. For this reason, and since the countries are aspiring EU members, EU action to tackle air pollution inevitably needs to include the Western Balkans as well.

The need for governments and utilities to cut pollution is now greater than ever. Due to the lack of timely action, the measures to be taken now need to be drastic. People's health cannot wait for years until plants close or pollution control equipment is installed.

Plants operating under the opt-out regime must limit their operation to 20,000 hours between 2018 and the end of 2023, after which they need to close.[5] But governments and utilities also need to consider closing the plants included in NERPs earlier than planned and reducing their operating hours in the meantime, particularly the oldest plants and those which require the highest investments to become LCPD-compliant.

In order to minimise the need to keep old coal plants online, investments in solar, wind and the reduction of grid losses need to be ramped up, and the use of efficient heat pumps for households instead of electrical resistance heaters must be increased. The development of National Energy and Climate Plans provides an opportunity to step up ambitions in this field, define fossil fuel phase-out dates, and update current, unrealistic national plans. This also means that plans for a just transition of the coal mining regions need to be speeded up, and need to be planned in a participatory manner.[6]

For those plants which cannot be closed within the next few years, the most urgent matter is to ensure that the Ugljevik and Kostolac B desulphurisation units function properly. Investments in pollution control equipment also need to be speeded up at a limited number of other plants such as Kakanj 7, Tuzla 6 and Kosova B, and in the meantime, operating hours need to be reduced to decrease the pollution burden of these plants.

In order to achieve efficiency of investments and to some extent reduce the burden of these plants on human health, any new pollution control equipment should ensure that plants meet the latest EU standards,[7] rather than just the obligatory minimum ones. It is also crucial to ensure that the equipment is of sufficient quality and that it is used in reality – and not switched off – to actually reduce pollution. Publishing real-time emissions data from continuous monitoring would help to build public trust that this is really the case.

The Energy Community needs to have stronger tools at its disposal to enforce the legislation under the Treaty, for the benefit of human health and the environment. The European Commission needs to strengthen its dispute settlement mechanism to include dissuasive penalties for breaches, and to include electricity imports in its forthcoming carbon border adjustment mechanism (CBAM). Mechanisms for carbon dioxide (CO_2) pricing need to be introduced as soon as possible in the Energy Community countries to level the playing field in the European electricity market.

To ensure as rapid a transition from coal as possible, the EU and other international donors need to assist the countries in energy saving and sustainable forms of renewable energy. However, in order to ensure that the 'polluter pays' principle is applied, public funds must no longer be used for pollution control investments at coal plants or for any other fossil fuel investments. Any investments must be carried out at the operators' own expense.

[5] *The other option is to undergo major reconstruction to comply with the emission limit values for new plants under the Energy Community Treaty, but we are sceptical that this would be economically feasible in the majority of cases.*

[6] *For more information, see also CEE Bankwatch Network, Eight steps for a just transition in the Western Balkans, 18 May 2021.*

[7] *Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants (notified under document C(2017) 5225)*

Introduction

Since the Large Combustion Plants Directive (LCPD) entered into force in the Energy Community in 2018, we have analysed the countries' compliance with their NERPs in two editions of the *Comply or Close* report. In 2020, we look at the cumulative three-year scale of non-compliance.

The LCPD was included in the Energy Community Treaty when it was signed in 2005. For a treaty whose aim is to open and unify the energy market of the EU with that of its immediate neighbours in southeast and eastern Europe, the inclusion of environmental legislation in the Treaty is crucial to level the playing field and prevent emissions leakage.

National Emissions Reduction Plans (NERPs) allow countries to sum up emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x) and dust from some or all of their power plants and comply with an overall emissions ceiling, instead of having each plant comply with the emission limits stipulated in the annexes of the Directive. Developing a NERP is only one of the options for complying with the Directive; the countries chose whether to develop one or not.[8] The NERP allows combustion plants to derogate from individual compliance with the emission limit values (ELVs) for existing plants set up in Annex V, part 1 of the LCPD until 2027. Instead, the NERP establishes periodic annual ceilings (2018, 2023, 2026 and 2027) which all plants' emissions combined must not go above, irrespective of their individual emissions.

Better performing plants for one pollutant can make up for worse performing ones, if the overall limit is met. Thus, NERPs already represent a compromise compared to full compliance by each unit: failure to even comply with NERP ceilings is thus extremely problematic.

Existing combustion plants may be exempted from the ELVs specified in the LCPD or from inclusion in a NERP if the operator opts for a limited lifetime derogation. This allows the power plant to run for no more than 20,000 hours starting from 1 January 2018 and ending no later than 31 December 2023, without having to comply with certain emission limit values or ceilings. This derogation is applied to units which are foreseen to be either closed or completely refurbished to comply with the newer and stricter Industrial Emissions Directive ELVs at the end of the derogation period.

Coal plants which comply with the Large Combustion Plants Directive still have health impacts, but those which do not are unnecessarily increasing ill health and premature deaths. Complying with the NERP ceilings and opt-out conditions are therefore not just a matter of compliance, but of life and death.

Taking action to reduce pollution is therefore imperative and long overdue. This three-year round up report looks at the official reported data for 2020 to see how the situation has evolved since 2018. It provides a regional overview of the results and an overview of the health impact data across the region and for the EU, together with country profiles for Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia.

[8] *Except Montenegro, which only has one large combustion plant and therefore cannot add up the total of several plants to make a national ceiling*

Exports of electricity to the European Union

The European Union has for two decades already been tightening its legislation on industrial emissions, climate change and state aid related to the coal sector, which has led to the decommissioning of many coal-fired power plants in the EU. Many EU Member States have announced ambitious plans to phase out coal within this decade with the help of the European Green Deal, which aims to make Europe the first climate-neutral bloc in the world by 2050.[9]

Using detailed hourly data[10] on the amount of electricity transmitted through each power line connecting the Western Balkans to the European Union, and the power generation mix in each country during each hour, we assessed how much of the coal-fired power generated in the region was exported to the EU.

The EU is a net importer of electricity,[11] including from the Western Balkans. The Western Balkans exported 25 TWh of electricity into the EU from 2018 to 2020, amounting to 8 per cent of total coal-fired power generation in the Western Balkans. Hence, the EU plays a significant role in sustaining coal-based electricity in the region.

The EU's imports of electricity from the Western Balkans make up only a miniscule 0.3 per cent of the EU's total electricity consumption,[12] but the emissions implications are extreme: **the SO_2 emissions associated with these imports are 50 per cent of the entire emissions from all power plants in the EU in 2020.**

This is because power generation in the Western Balkans emits around 300 times more SO_2 per unit of electricity produced than power generation in the EU. Moreover, in 2020 the total SO_2 emissions from coal-fired power in the Western Balkans were 2.5 times as high as the SO_2 emissions from all coal plants in the EU.

[9] *European Commission, Coal regions in transition, 2019.*

[10] *For more details, see Annex 1.*

[11] *European Commission, Electricity and heat statistics.*

[12] *European Commission, Electricity and heat statistics.*

[13] *ENTSO-E, Actual Generation per Production type, 2021*

Power generation and power sector SO_2 emissions in the EU and Western Balkans in 2020

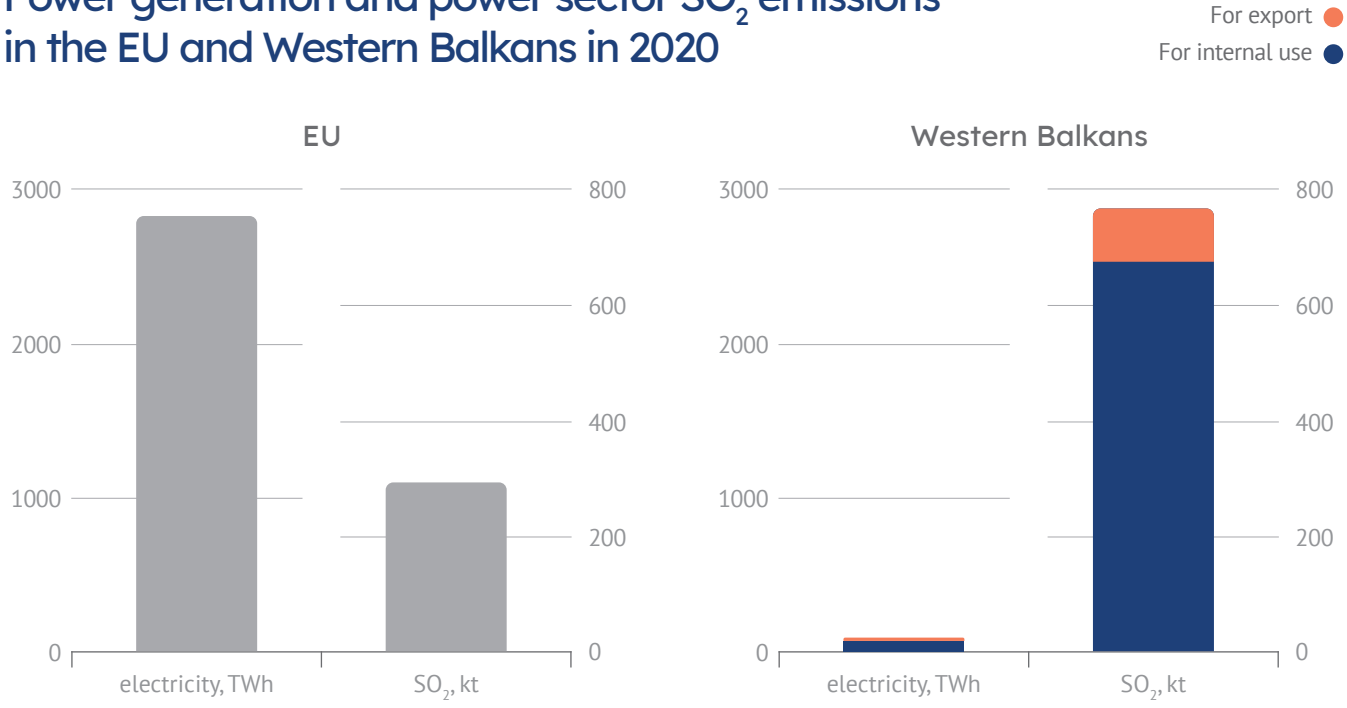

Figure 1: *Electricity generation and associated sulphur dioxide emissions in the EU and Western Balkans, 2020* [13]

The largest EU importers of this highly polluting electricity are Croatia, Greece, Hungary and Romania. For 2018, 2019 and 2020 combined, Western Balkan countries exported 10.2 TWh of electricity to Croatia, 7.3 TWh to Greece, 2.4 TWh to Hungary and 1.7 TWh to Romania.[14]

Total electricity exports to the EU with % of coal-based electricity

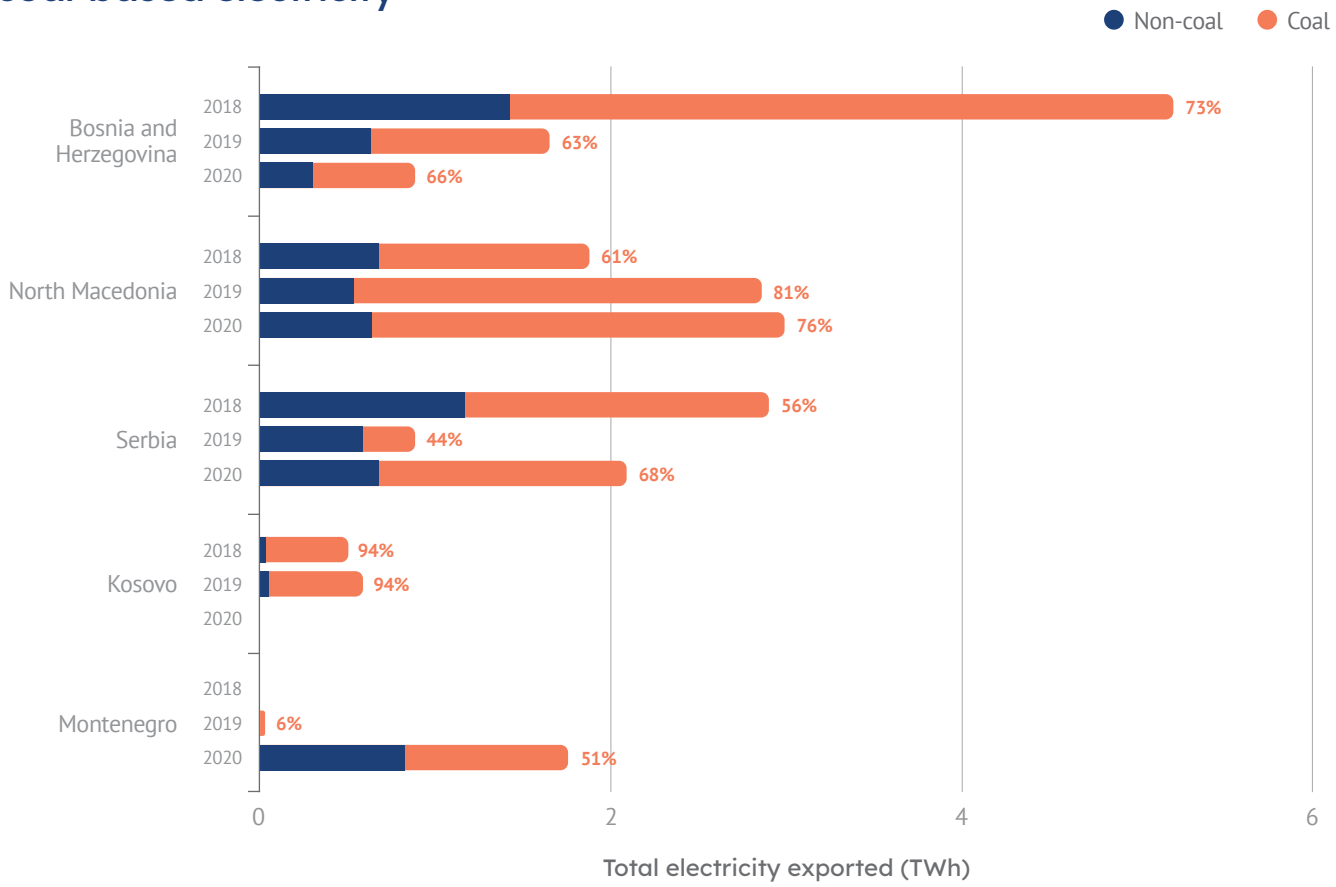

Figure 2: *Total electricity exports from Western Balkan countries into the EU, with the share of coal-based exports, 2018 to 2020*[15]

The overall picture of the Western Balkans' energy trading with the EU is mixed, with exports varying significantly by country and year.

Bosnia and Herzegovina's electricity exports to the EU declined in 2019 and 2020, partly due to poor hydrological conditions affecting hydropower generation. Overall electricity generation and consumption saw a slight decline in 2020 compared to 2019, with a total of 15.4 TWh of production and 11.3 TWh of domestic consumption – the highest balance surplus in southeast Europe.[16]

Total electricity exports (to all countries, not only the EU), were three times as large as imports, at 5.5 TWh in 2020,[17] with the majority going to Serbia and Montenegro and just under 1 TWh to the EU (Croatia) as shown in Figure 1 above. By 2020, the share of coal in exports had decreased to 66 per cent from 73 per cent in 2018, but this was still two-thirds of exports. Around a third of Bosnia and Herzegovina's electricity generation is made up of hydropower,[18] but this is highly dependent on weather conditions – in 2020, poor conditions led to a 24.3 per cent decrease in electricity generation from hydropower plants compared to the previous year.[19]

In 2019, 95 per cent of Kosovo's generation was derived from coal-fired power plants, while the rest came from hydropower, wind and a small amount of solar.[20]

[14] *ENTSO-E, Cross-border physical flow, 2021.*

[15] *Regarding the figures for Serbia and Kosovo, see Annex 1 on methodology. Since disaggregated data was not available, these are based on assumptions that some of the electricity exported from Kosovo to Serbia reaches the EU, which may or may not be the case.*

[16] *State Energy Regulatory Commission (DERK), Annual Report, 2020.*

[17] *State Energy Regulatory Commission (DERK), Annual Report.*

[18] *CEE Bankwatch Network, The energy sector in Bosnia and Herzegovina, accessed 10 June 2021.*

[19] *State Energy Regulatory Commission (DERK), Annual Report.*

[20] *Energy Regulatory Office, Annual report 2019, 2020.*

However, electricity generation in Kosovo is inefficient; on any given day, Kosovo can both require imports to cover domestic demand and also produce electricity surpluses.[21]

In North Macedonia, exports have grown over the past few years, with the value of exports in 2020 increasing by 9 per cent compared to 2019, and 70 per cent compared to 2018.[22] Bulgaria and Greece are the main electricity importers, importing 2.8 TWh of electricity from North Macedonia in 2020, of which 76 per cent was coal-based.[23] The total renewable energy production in 2020 was recorded as 1.49 TWh – an increase compared to 2019 but still less than 2018,[24] presumably due mainly to hydrological conditions.

Montenegro's electricity market saw many substantial changes in 2019; the main electric power company Elektroprivreda Crna Gora (EPCG) was renationalised, and the electricity network was connected with Italy in November 2019.[25] In 2019, Italy imported only 0.012 TWh of electricity from Montenegro. This number drastically increased to 1.6 TWh in 2020, of which just over half – 51.1 per cent – was coal-based.[26]

By the end of 2019, Serbia only had four wind power plants connected to its transmission system. In 2020, Serbia exported its electricity mainly to four EU countries – Bulgaria, Croatia, Hungary and Romania. The percentage of coal in 2018 in exports to these four countries ranged between 59 per cent and 64 per cent, but in 2020 the share of coal in exports had risen to between 66 per cent and 70 per cent.[27]

[21] *Energy Regulatory Office, Annual report 2019.*

[22] *Energy Regulatory Commission, Annual report 2019, 2020.*

[23] *ENTSO-E, Cross-border physical flow, 2021.*

[24] *Energy Regulatory Commission, Annual report 2020, 2021.*

[25] *European Commission, Montenegro 2020 Report Accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 6 October 2020.*

[26] *ENTSO-E, Cross-border physical flow.*

[27] *ENTSO-E, Cross-border physical flow.*

Pljevlja, Montenegro
Photo credit: RTV Pljevlja (for Green Home)

Regional overview of pollutant emissions[28]

By 1 January 2018, the deadline for LCPD compliance in the Energy Community countries, the coal power plant operators in the Western Balkans should have invested in pollution control equipment to comply with the emission limit values from the Directive, or at least to comply with the national ceilings laid out in the National Emissions Reduction Plans. The countries had 12 years after signing the Treaty to do so. But despite this, not one of the countries with large combustion plants[29] ensured that their coal power plants comply with the emission limit values from the Directive by 2018.

Nor did any of the four countries with NERPs – Bosnia and Herzegovina, Kosovo, North Macedonia and Serbia – comply with the 2018 ceilings for sulphur dioxide or dust they had committed to in their plans.

In fact, in both 2018 and 2019, sulphur dioxide emissions from the coal power plants included in the NERPs were, in total, around six times as high as the sum of the countries' emissions ceilings.[30] Total dust emissions were also almost 1.6 times as high as the sum of the allowed ceilings, with only emissions of nitrogen oxides remaining within the limits set by the NERPs.

For this reason, in March 2021, the Energy Community Secretariat opened dispute settlement cases against Bosnia and Herzegovina, Kosovo, North Macedonia and Serbia for failure to adhere to their NERP ceilings in 2018 and 2019.[31]

In 2020, a drop in emissions might have been expected due to the reduction of economic activity as a result of the COVID-19 pandemic. But this was far from the case. **In fact, sulphur dioxide emissions from the coal plants included in the NERPs increased compared to 2018 and 2019. They were 6.4 times as high as the sum of the countries' ceilings.**

[28] *Where available, we have used verified emissions figures from the European Environment Agency for 2018 and 2019, which may lead to some figures being somewhat different than those quoted in the previous Comply or Close reports.*

[29] *Albania has no functional large combustion plants. The 98 MW oil and gas plant at Vlore has never worked commercially due to technical problems.*

[30] *In some cases, these ceilings also include emissions from gas or oil plants, which are not included in our study, so the exceedances by the coal plants are particularly high.*

[31] *Energy Community Secretariat, Secretariat initiates dispute settlement procedures against four Contracting Parties in relation to NERPs, 16 March 2021.*

Sulphur dioxide emissions from Western Balkan NERP coal plants compared to the allowed emissions celilings

SO_2	Emissions	Ceiling
2018	606,467	103,682
2019	621,553	103,682
2020	660,700	103,682

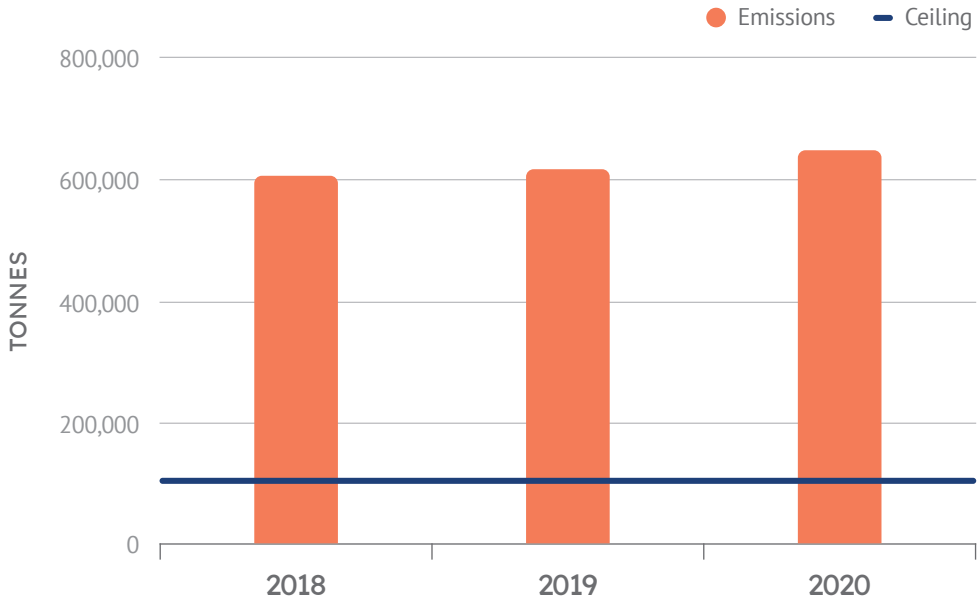

Figure 3: *Sulphur dioxide emissions from the Western Balkan NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

In 2020, total dust emissions were still 1.6 times as high as the countries' combined ceilings, and in absolute terms had even increased somewhat. Both Kosovo and Bosnia and Herzegovina exceeded their national ceilings for dust.

Dust emissions from Western Balkan NERP coal plants 2018-2020 compared to the allowed emissions celilings

Dust	Emissions	Ceiling
2018	17,414	11,199
2019	17,557	11,199
2020	18,246	11,199

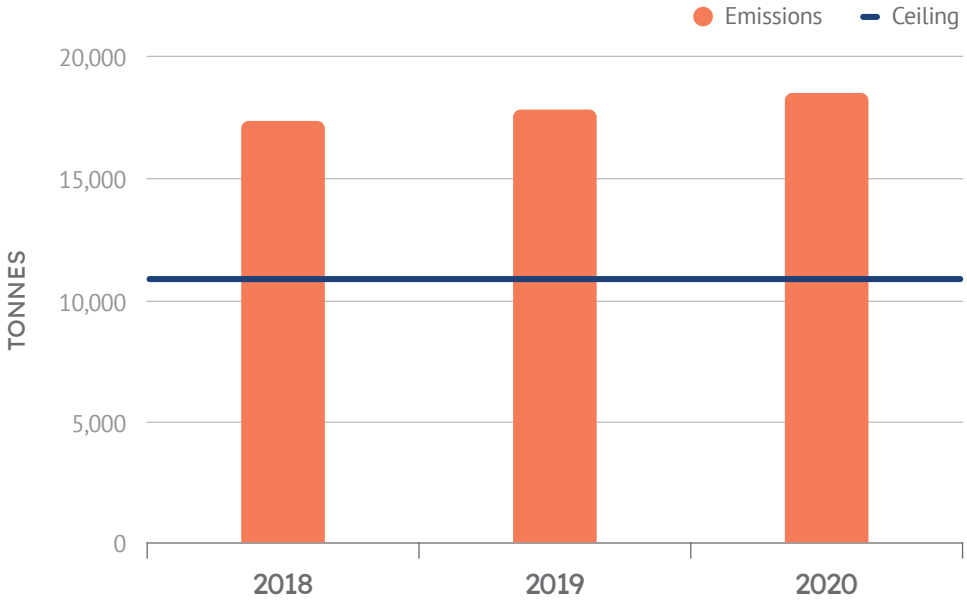

Figure 4: *Dust emissions from the Western Balkan NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Only total emissions of nitrogen oxides were still below the combined regional total ceiling for 2020. However, Kosovo and Bosnia and Herzegovina exceeded their ceilings. Moreover, regionally, NO_x emissions have slightly increased since 2018: by 2020, emissions had reached 0.9 times the combined ceilings for NO_x. With the annual ceilings tightening every year, more breaches are likely to occur for this pollutant in the coming years.

Nitrogen oxides emissions from Western Balkan NERP coal plants 2018-2020 compared to the allowed emissions celilings

NO_x	Emissions	Ceiling
2018	77,068	107,353
2019	72,136	97,226
2020	79,694	87,100

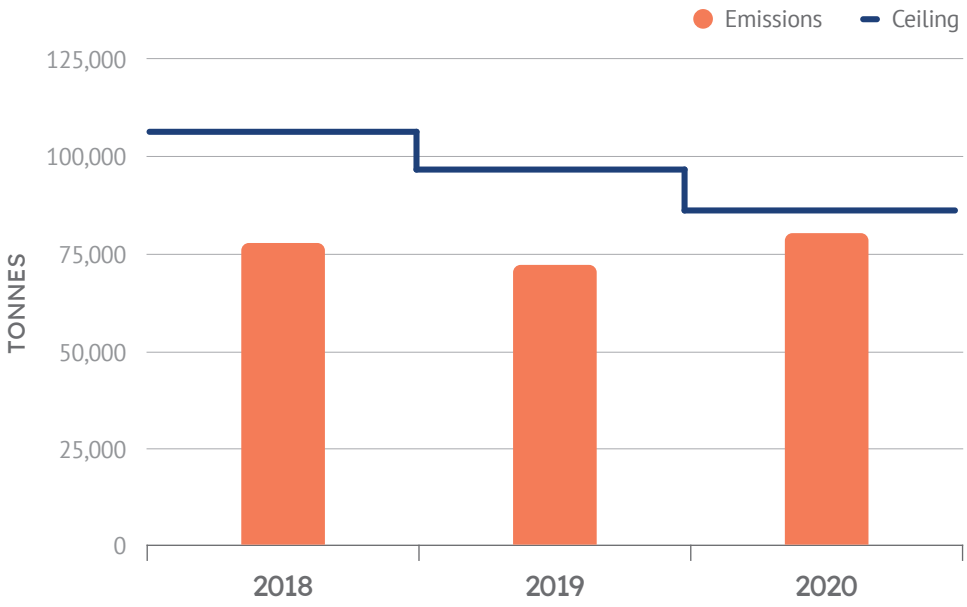

Figure 5: *Nitrogen oxides emissions from the Western Balkan NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

In fact, many of the figures provided by the power plant operators are estimates rather than the result of continuous monitoring. The Large Combustion Plants Directive[32] also obliges the countries to install and operate continuous emissions monitoring equipment, but to this day, almost half of the coal-fired power plants in the Western Balkans either have no such devices in place, or the devices in place do not work.

Therefore, emissions data for all countries is at least partially based on estimates derived from once-monthly measurements and sometimes even measurements carried out once every three months.

In 2020, Serbia's NERP plants were the highest SO_2 emitters, with 333,602 tonnes, followed by Bosnia and Herzegovina with 220,411 tonnes.

The SO_2 emissions from Serbia's coal power plants also overtook those from the 221 plants in the entire European Union in 2020.[33]

In absolute terms, Ugljevik in Bosnia and Herzegovina was once again the highest-emitting unit for SO_2 in the region in 2020, with 107,402 tonnes. This means that one plant alone emitted more than all the plants in the four countries were allowed to.

Despite the fact that a desulphurisation unit started test operations in December 2019, Ugljevik's 2020 emissions were 19,000 tonnes higher than in 2019. In early 2020, technical problems were reported, and at the time of writing in June 2021 they do not appear to have been resolved. It therefore remains to be seen when and whether the benefits of this investment will ever be felt.

In terms of breaching individual ceilings, Kakanj 7 in Bosnia and Herzegovina was the worst offender in 2020, emitting almost 15 times as much as allowed. It was followed by Ugljevik and Kostolac B1+2 in Serbia, both of which emitted almost 12 times as much as allowed.

Like Ugljevik, Kostolac B has also had desulphurisation equipment fitted. A unit installed by the China Machinery Engineering Corporation (CMEC) that was inaugurated in 2017 is still not in commercial operation. In April 2021, the Ministry of Mining and Energy announced[34] that, in fact, the facility has been undergoing test operations since October 2020, but the results of these have yet to show up in the emissions figures.

Concerning dust, regionally the absolute highest emitter in 2020 was Kosova B unit 1, with 2,797 tonnes. It also had the highest exceedance of its ceiling, emitting 6.6 times as much dust as allowed. Other very high dust emitters in the region included Kosova B2, emitting almost 6 times as much as allowed; Gacko in Bosnia and Herzegovina, emitting 5.5 times as much as allowed; and Bitola 1-2 in North Macedonia, emitting 3.3 times as much as allowed.

For nitrogen oxides, Kakanj 7 in Bosnia and Herzegovina and Kosova A4 were the worst offenders, both emitting more than twice as much as allowed. Other plants emitted much more in absolute terms, but not all exceeded their allotted ceilings.

Going beyond the countries with NERPs, Montenegro also became non-compliant with the LCPD in 2020, by using up the 20,000 hours of operation that Pljevlja is allowed under the opt-out regime and continuing to operate the plant. For this reason, the Energy Community Secretariat opened a dispute settlement case against Montenegro in April 2021.[35]

Thus, on the regional level, not only was there no improvement between 2018 and 2020, but sulphur dioxide, dust and nitrogen oxide emissions *increased* instead of decreased. In the following sections, the countries' individual ceilings and pollution are explained in more depth.

[32] *Article 12 of the Large Combustion Plants Directive*

[33] *We estimated the SO_2 emissions in the European Union by taking the latest available emissions figure for each plant from the EEA Industrial Reporting Database, from 2017 to 2019 depending on the country, and scaling that figure by the change in plant CO_2 emissions from the data year to 2020, reported to the Union Registry for the European Emissions Trading Scheme, assuming that the ratio of SO_2 to CO_2 emissions stayed constant. This is bound to overestimate SO_2 emissions, as emissions control improvements will have lowered the ratio.*

[34] *Beta, 'Ministarstvo: Emisije sumpordioksida u Kostolcu B u okviru propisanih vrednosti', N1, 30 April 2021.*

[35] *Energy Community Secretariat, Secretariat launches dispute settlement procedure against Montenegro for breaching Large Combustion Plants Directive as TPP Pljevlja exhausts 'opt-out', 20 April 2021.*

Health impact analysis – regional level

We compiled officially-reported emissions data for major air pollutants from every coal-fired power plant in the Western Balkans from 2018 to 2020. This data was used to carry out detailed atmospheric simulations of the pollutant dispersion and air quality impacts, and to further assess the public health impacts of coal power plant emissions.

Besides the total health impacts of emissions from coal plants, we projected the health impacts linked to exceedances of emissions ceilings (see Table 1), and to electricity exports to the EU. These health impacts would have been avoided, if all plants complied with their emissions ceilings and if the EU didn't import electricity from the Western Balkans, respectively.

The atmospheric model used for the simulations was developed under the European Monitoring Programme (EMEP) of the Convention on Transboundary Pollution (CLRTAP), of which the Western Balkan countries (with the exception of Kosovo) are parties, giving the model an official status. The model simulates the dispersion, chemical transformation and deposition of pollutants in the atmosphere, using a full year of meteorological data. Model predictions are validated against air quality measurements by EMEP in its annual reports.

The assessment of health impacts associated with the coal plants' emissions follows the WHO recommendations[36] for concentration-response functions and health impact assessment in Europe, as implemented in Huscher et al.[37]

How we projected the health impacts of coal-fired power plants

The methodology builds on scientific studies quantifying the increase in risk of death and other health outcomes when air pollutant concentrations increase by a certain amount. Using these concentration-response relationships, we project the reduction in risk for each location within the study region that would happen if the coal power emissions were eliminated, based on the atmospheric modelling results. Combined with high-resolution population data and country-level data on the incidence of different health outcomes, we then calculate the number of cases of those health outcomes attributed to coal power emissions. To estimate the economic losses related to the health impacts, we apply economic damage costs per case developed for the Cost-Benefit Analysis of the Clean Air For Europe legislative package (CAFE CBA), adjusted for the per capita income level in the Western Balkans. (See Annex 1, Materials and methods, for details.)

The results are expressed as a central estimate and a confidence interval that includes the uncertainty related to the concentration-response relationship. Ninety-five per cent confidence implies that in 19 cases out of 20, the value is expected to be within the confidence interval.

Nearly 19,000 deaths occurred from 2018 to 2020 over all modelled regions due to the total emissions of coal-fired power plants in the Western Balkans. Of these, more than 50 per cent (10,800) were in EU countries, almost 30 per cent (6,500) in the Western Balkans and the remainder in neighbouring countries. Total emissions of coal power plants resulted in health costs between EUR 25.3 billion and 51.8 billion.

[36] *World Health Organization (WHO), Health risks of air pollution in Europe-HRAPIE project, 2013.*

[37] *J. Huscher, L. Myllyvirta, and R. Gierens, 'Modellbasiertes Health Impact Assessment Zu Grenzüberschreitenden Auswirkungen Von Luftschadstoffemissionen Europäischer Kohlekraftwerke,' Umweltmedizin - Hygiene - Arbeitsmedizin 22, no. 2 (2017).*

Nearly 12,000 of these deaths resulted from the fact that the plants included in NERPs exceeded their ceilings between 2018 and 2020. More than half of these deaths occurred in EU countries, with 7,000 deaths affecting EU citizens, 3,700 deaths in the Western Balkans, and 960 in other regions affected by Western Balkan pollution.

Deaths	EU	Western Balkans	Others	Total for all regions
2018	2,320	1,180	320	**3,820**
2019	2,220	1,160	300	**3,680**
2020	2,490	1,350	340	**4,180**
Total	**7,030**	**3,690**	**960**	**11,680**

Table 1: *Estimated number of deaths caused by Western Balkan coal-fired power emissions exceedances in the EU, the Western Balkans and other neighbouring regions, 2018 to 2020*

In 2020, the country suffering the most from these emissions exceedances was Italy, with 605 deaths, followed by Serbia. Italy also had the most deaths attributed to Western Balkan exports, with 195 deaths. Greece and Serbia followed closely behind, with 180 and 165 deaths, respectively.

Affected country	Deaths due to emissions exceedances
Italy	**605**
Serbia	**600**
Hungary	**390**
Romania	**360**
Bosnia and Herzegovina	**280**
Greece	**240**
Bulgaria	**220**
Ukraine	**215**
Croatia	**181**
Albania	**145**

Affected country	Deaths due to electricity exports from WB to the EU[38]
Italy	**195**
Greece	**180**
Serbia	**165**
Albania	**110**
North Macedonia	**105**
Romania	**95**
Hungary	**80**
Bulgaria	**75**
Bosnia and Herzegovina	**70**
Ukraine	**60**

Table 2: *Top ten countries with the highest number of deaths due to electricity exports and emissions exceedances of Western Balkan coal plants, 2020*

The table shows the impacts of emissions exceedances from Western Balkan power plants, including transboundary impacts on countries outside the region, broken down by affected country.

[38] *This means the deaths resulting from the amount of coal-generated electricity that was exported to the EU, which can result in deaths in other countries as well, not only in the generating country and the EU country buying the electricity.*

Coal-fired power plants' health impacts in the five Western Balkan countries are not restricted to only deaths, but include other health impairments as well. The emissions exceedances for 2018, 2019 and 2020 of all the coal plants combined caused a total of around 130,000 days of asthma symptoms in asthmatic children living in the EU. Over 11,000 children were affected by bronchitis for the three years combined in the EU, just over 50 per cent of the total cases of bronchitis cases in children.

Cause	EU	Western Balkans	Others	**Total** for all regions
Restricted activity days	3,494,000	2,013,000	547,000	**6,054,000**
Work days lost	779,000	382,000	50,000	**1,211,000**
Asthma symptom days in asthmatic children	45,000	26,000	8,100	**80,000**
Bronchitis in children	4,000	2,600	890	**7,500**
Cardiovascular and respiratory hospital admissions	1,800	1,000	270	**3,100**
Chronic bronchitis in adults	1,200	670	170	**2,100**
Low birth weight	270	320	70	**660**

Table 3: *Health impacts from Western Balkan power plant emissions exceedances, 2020*

Emissions exceedances from Western Balkan power plants caused a total of 1.2 million work days lost in 2020 alone. Hospital admissions due to cardiovascular and respiratory symptoms amounted to 3,000, with the EU having an estimated total of 1,800 hospital admissions. Over 6 million days were lost to restricted activity with almost two thirds (3.5 million) affecting EU countries, and a third (2 million) affecting Western Balkan countries. All of these in turn cause losses in productivity.

Region	Total cost, EUR million (central value)	Total cost, EUR million (95% confidence interval)
EU	6,738	4,424–8,908
Western Balkans	1,965	1,284–2,604
Other countries[39]	508	333–673
Total	**9,211**	**6,041–12,185**

Table 4: *Annual health damage costs from Western Balkan coal plant emission exceedances, 2020*

The modelled results show that between EUR 6.0 billion and 12.1 billion is estimated to have been incurred in costs in 2020 due to emission exceedances from the Western Balkans' coal plants. Close to three quarters of these (73 per cent) relate to people and countries in the EU (EUR 4.4 to 8.9 billion), 21 per cent or between EUR 1.3 to 2.6 billion to Western Balkan countries and the remaining 6 per cent to other countries. The costs are borne both at the individual and national levels; through personal costs for medical treatment, increased national healthcare budgets and reduced productivity (which exacerbates the economic impact).

[39] *Algeria, Belarus, Liechtenstein, Moldova, Russia, San Marino, Switzerland, Tunisia, Turkey, Ukraine, Vatican City.*

Country	Total cost, EUR million (central value)	Total cost, EUR million (95% confidence interval)
Italy	2,993	1,965–3,957
Serbia	1,675	1,086–2,231
Hungary	1,508	985–1,999
Romania	1,321	863–1,752
Greece	847	555–1,120
Croatia	661	432–877
Bulgaria	649	423–862
Bosnia and Herzegovina	627	408–831
Poland	547	359–723
Germany	448	295–590

Table 5: *Top 10 countries with the highest health costs due to total emissions of Western Balkans' coal power plants (EU and Western Balkan), 2020*

Looking at the costs on a country-level, EU countries bordering the Western Balkans, such as Italy, Greece, Croatia, Hungary and Romania, bear the biggest health cost burden of the transboundary air pollution from coal – all estimated at central values of over EUR 1 billion in 2020. Italy is estimated to have endured the largest health damage costs in 2020, with a range of EUR 2.0 billion to EUR 4 billion. These economic burdens may also aggravate existing health, social and economic inequalities, and put pressure on healthcare systems and budgets that have already felt increased strain due to the COVID-19 pandemic.

Understanding deaths related to air pollution

Numerous long-term health studies have shown that people living in areas with higher average concentrations of PM2.5, NO_2 and ozone have a higher risk of death from chronic diseases including strokes, lung cancer, chronic obstructive pulmonary disease, diabetes and ischemic heart disease. The findings of these studies have allowed scientists to develop concentration-response functions that show how deaths increase or decrease when air pollutant levels change. Combining these functions with data on population and observed number of deaths, we can project how many deaths would have been avoided if the fraction of air pollution attributed to Western Balkans coal power plants had been eliminated.

For a long time, scientists were only able to measure the short-term effects of air pollution affecting mainly people who are already severely ill. In contrast, based on the body of evidence accumulated over the past two decades, the deaths linked to air pollution are mainly related to chronic exposure over several years. The lost number of life years associated with each air pollution-related death in Western Balkans is around 20 years.[40]

[40] *Institute for Health Metrics and Evaluation, GBD results tool, accessed 2 July 2021.*

Country profiles

Bosnia and Herzegovina (BiH)

Compliance with the NERP ceilings in 2020

Bosnia and Herzegovina's NERP[41] currently covers seven coal-fired units[42] and one smaller plant using heavy fuel oil. Another three coal plants are subject to limited lifetime derogations ('opt-outs'), allowing them to run for a total of 20,000 hours between 1 January 2018 and 31 December 2023, after which they either need to close or comply with the emission limit values for new plants under the Industrial Emissions Directive. These three are Tuzla 3, Tuzla 4, and Kakanj 5.[43]

BiH also has one newer plant which does not qualify for inclusion in the NERP – Stanari, which officially started operations in September 2016 and was obliged to comply with LCPD limit values from the outset.

The plants included in Bosnia and Herzegovina's NERP, along with those included in Kosovo's, have the dubious distinction of not complying with the pollution ceilings for any of the required pollutants: sulphur dioxide, dust or nitrogen oxides.

The most serious breaches, as with other countries, are for sulphur dioxide. In 2020, sulphur dioxide emissions from the NERP plants in BiH reached almost ten times as much as allowed – 220,411 tonnes compared to the ceiling of 22,195 tonnes. Absolute emissions increased in 2020 compared to 2018 and 2019.

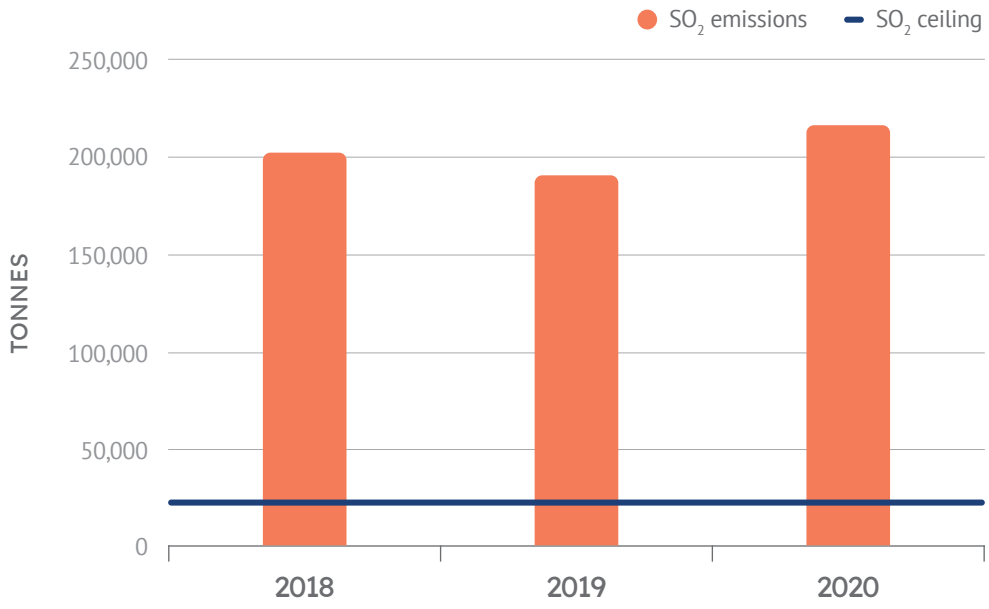

Figure 6: *Sulphur dioxide emissions from Bosnia and Herzegovina's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Kakanj 7 again had the highest exceedance in 2020 – almost fifteen times its ceiling. It too emitted more sulphur dioxide than in 2019. Dust emissions in 2020 amounted to 2,686 tonnes compared to the ceiling of 1,689 tonnes.

This was largely due to massive dust emissions from the Gacko plant, which were more than five times as high as the plant's ceiling, and from the Ugljevik plant, which were twice as high as the plant's ceiling.

[41] *USAID, National Emission Reduction Plan for Bosnia and Herzegovina, November 2015.*

[42] *The NERP text also includes Kakanj 5 and Tuzla 4, but these were later approved as opt-out plants so the ceilings in the NERP do not include the contribution of these plants.*

[43] *Energy Community Secretariat, Report on the final list of opted-out plants, April 2018.*

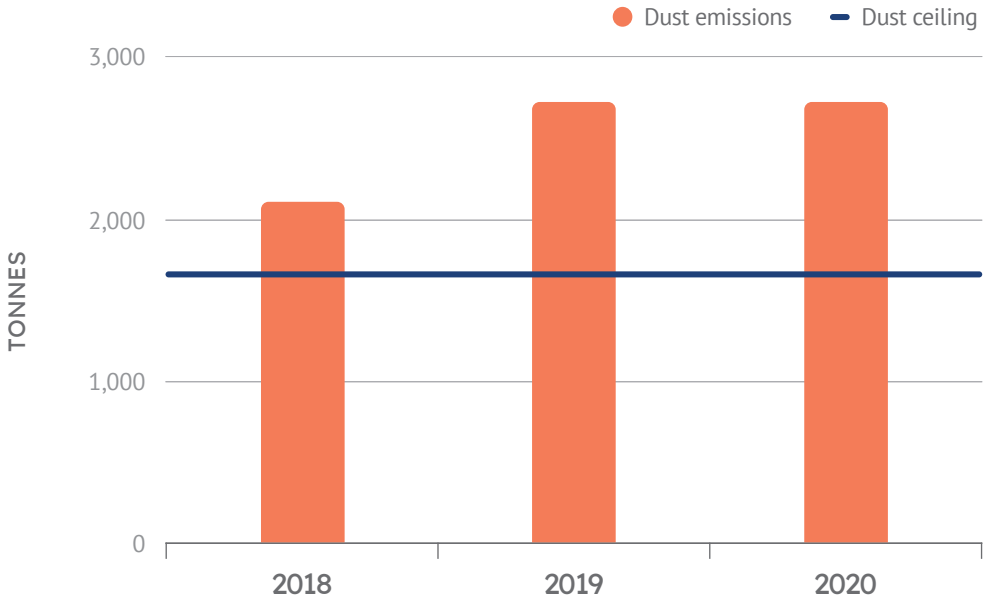

Figure 7: *Dust emissions from Bosnia and Herzegovina's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Nitrogen oxide emissions in 2020 totalled 16,367 tonnes, compared to the ceiling of 12,365 tonnes. Here too, Kakanj 7 had the highest exceedance, with more than double the allowed emissions.

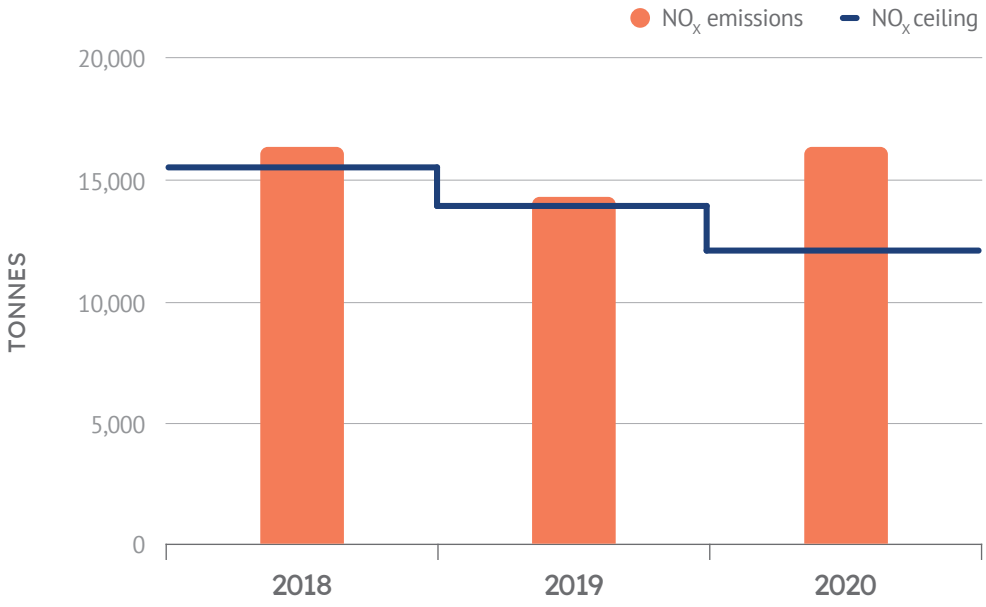

Figure 8: *Nitrogen oxide emissions from Bosnia and Herzegovina's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Bosnia and Herzegovina (2020)

SO_2 ceiling[44]	SO_2 emissions	Dust ceiling	Dust emissions	NO_x ceiling	NO_x emissions
22,195	220,411	1,689	2,686	12,365	16,367

[44] *The original BiH ceilings in the NERP included Kakanj 5 and Tuzla 4, which were later included in the opt-out regime, so the calculations for the ceiling for all years (from 2018 to 2020) were based on the sum of the ceilings for the other plants.*

Health impacts

Health impact	Pollutant	Number of cases, 2020	95% confidence interval	Cost (EUR million)	95% confidence interval
Asthma symptoms in asthmatic children	PM_{10}	25,639	5,554-46,183	0.69	0.15-1.24
Bronchitis in children	PM_{10}	2,373	0-5,364	0.86	0-1.95
Cardiovascular hospital admissions	$PM_{2.5}$	489	92-889	0.68	0.13-1.24
Incidence of chronic bronchitis in adults	PM_{10}	685	243-1,072	36.6	13.0-57.2
Mortality, all causes	all	1,345	876-1,783	2,885.9	1,880.1-3,828
Respiratory hospital admissions	$PM_{2.5}$	480	0-1,006	0.64	0-1.35
Restricted activity days	$PM_{2.5}$	1,969,182	1,763,942-2,214,180	81.3	72.8-91.39
Work days lost	$PM_{2.5}$	406,169	345,527-466,407	38.1	32.4-43.7

Table 6: *Total health impacts and related costs due to emissions exceedances of Bosnia and Herzegovina's power plants (NERP), 2020*

The health impacts and related costs due to Bosnia and Herzegovina's power plants' emissions exceedances are incurred in all countries and regions, not limited only to Bosnia and Herzegovina. The Ugljevik and Kakanj power plants are among the five plants in the Western Balkans with the worst health impacts due to exceedances of emissions ceilings. Ugljevik caused the most days of asthmatic symptoms in children in 2020, with over 12,000 days. This is equal to 48 per cent of all such impacts from the country's NERP power plants. Kakanj units 6 and 7 were close behind, with 8,050 days of asthmatic children suffering from asthmatic symptoms. Tuzla 5 and 6 come in a distant third, with 3,236 of such days in 2020.

Ugljevik is also responsible for the highest number of cases of bronchitis in children due to PM10, and of hospital admissions because of cardiovascular and respiratory symptoms, with 1,142 cases of the former and 469 of the latter in 2020. Hospital admissions cost an estimated total of EUR 1.32 million (with a confidence interval of EUR 0.13 million to EUR 2.59 million). The high costs incurred due to Bosnia and Herzegovina's NERP plants exceeding the emissions limits include almost EUR 2.9 billion from the 1,345 deaths and EUR 119 million from restricted activity days and work days lost.

Ongoing investments

Bosnia and Herzegovina has so far been reluctant to come up with a clear plan to phase out coal. The opt-out plants must be closed when they reach the limit of 20,000 operating hours or at the end of 2023 latest. But official[45] projections that several of the NERP plants will operate beyond 2030 seem highly unrealistic given that their average age is already 40 years.

Elektroprivreda Bosne i Hercegovine (EP BiH), one of the Federation of BiH's public electricity utilities companies, plans to invest in desulphurisation for Kakanj 7 and Tuzla 6 but does not appear to have secured any funds for this yet, according to its latest operational plan.[46]

[45] *E.g. from the Framework Energy Strategy of Bosnia and Herzegovina until 2035, 68, accessed 2 July 2021.*

[46] *Elektroprivreda Bosnia and Herzegovina, Revidovani Plan Poslovanje za period 2021. -2023. godina, May 2021.*

In early 2021 it opened a tender process for desulphurisation for Kakanj 7,[47] but it is not clear whether a contractor has been selected. Considering how long the Ugljevik and Kostolac B3 desulphurisation projects have taken to be implemented, this does not bode well for the protection of public health in the coming years. Nor does it clarify when the other plants will be closed, or how the dust and NO_x breaches will be addressed.

In the case of Ugljevik, the desulphurisation equipment is still not functioning 12 years after the financing contract was signed. Financed by a loan from the Japan International Cooperation Agency (JICA) signed back in 2009,[48] works on the de-SO_x equipment started only in 2017 and test operations began in December 2019.[49] It seemed likely that in 2020, SO_2 emissions would be significantly lower, finally justifying the EUR 85 million investment.[50]

However, in February 2020 technical problems were reported. The plant's dust filters, overhauled more than three years ago by the Czech company Termochem[51] at a cost of around EUR 10 million, were faulty, and their proper functioning is a precondition[52] for desulphurisation. The plant operator spent an additional EUR 100,000 on a study that would show how to address the problem.[53]

As of February 2021, the plant still didn't have an operating permit for the new installation. RiTE Ugljevik, the power plant operator, sought 'technical assistance' to obtain the permit, adding an extra EUR 100,000 to the costs of this project. [54]

The contract was awarded to a company owned by the mayor of Zvornik,[55] raising a host of questions on why the publicly-owned utility RiTE Ugljevik is not capable of obtaining an operating permit itself.

Kakanj power plant, Bosnia and Herzegovina
Photo credit: Center for Environment

47 *Akta, Otvoren poziv za izgradnju postrojenja za odsumporavanje u TE Kakanj, posao od 117 mil. KM, 4 January 2021.*

48 *Japan International Cooperation Agency, Commencement of works in Ugljevik TPP in Bosnia and Hercegovina, 15 May 2017.*

49 *Iskra Pavlova, 'Bosnia's Ugljevik 82 mln euro desulphurisation project nears completion', SEE News, 2 July 2019.*

50 *RiTE Ugljevik, Postrojenje za odsumporavanje predato na upravljanje preduzeću, 28 October 2020.*

51 *ZK-Termochem website, last accessed 26 May 2021.*

52 *Dejan Tovilović, 'Zbog nemara ugrožena investicija od 83 miliona evra', Capital.ba, 27 February 2020.*

53 *Dejan Tovilović, 'Česi uzeli 20 miliona, a ugradili oštećene dijelove', Capital.ba, 13 July 2020.*

54 *Dejan Tovilović, 'RITE Ugljevik neće pokrenuti postrojenje od 165 miliona do kraja 2021?', Capital.ba, 9 February 2021.*

55 *Dejan Tovilović, 'Firma gradonačelnika Zvornika popravlja elektrofiltere na „TE Ugljevik"', Capital.ba, 12 April 2021.*

Kosovo

State of play with the NERP

All of Kosovo's five coal-fired units (Kosova A3, A4, A5 and Kosova B1 and B2) are included in the NERP.

The country's NERP was adopted by the Government of Kosovo in May 2018,[56] five months after it should have entered into force and been transposed into national regulations. The NERP was uploaded on the Office of the Prime Minister's website in September 2019,[57] but the document still carries a 'draft' watermark.

On 12 July 2019, the Energy Community Secretariat submitted a Reasoned Request to the Energy Community Ministerial Council for a decision under Article 91 of the Energy Community Treaty concerning Kosovo's incomplete transposition and lack of implementation of Directive 2001/80/EC on large combustion plants (case ECS-6/18). On 16 March 2020, the Ministerial Council took a decision via written procedure on Kosovo's failure to comply with Article 16 of the Treaty. In Article 2 of the Decision, the ministers urged Kosovo to rectify the identified breaches and ensure compliance with Energy Community law immediately.[58]

On 16 March 2021, the Energy Community Secretariat opened a new infringement procedure (case ECS-08/21)[59] by sending an Opening Letter to Kosovo to address the country's failure to comply with the emission ceilings in the NERP for the reporting years 2018 and 2019. The Secretariat concludes that Kosovo failed to comply with one or more of the ceilings (for sulphur dioxide, nitrogen oxides and dust) in the NERP. Furthermore, the country failed to provide emission scenarios that would ensure compliance with the provisions of the plan in the coming years. No further information regarding the progress towards rectifying the non-compliance is available at the time of writing (June 2021).

Kosovo's NERP also stands out due to the inconsistencies between the ceilings for the three pollutants that appear in the main body of the document and those calculated in Annex 2 of the NERP. This annex is not part of the publicly available NERP and has been leaked to the authors of this report. The SO_2 ceilings listed in the main body of the NERP only follow a linear decrease until 2021, and then they increase slightly in 2022 and 2023. The dust ceiling will also increase slightly in 2023.

Therefore, in this report the authors have taken the ceiling values from the Annex, because they appear more in line with the Energy Community's policy guidelines for the preparation of NERPs,[60] even though the ceilings for SO_2 and NO_x are higher than those in the main body of the document.

Pollutant	NERP 2020 national ceiling (tonnes)	2020 national ceiling in Annex 2 (tonnes)
SO_2	10,150	11,057
Dust	3,302	1,382
NO_x	10,239	13,821

Table 7: *Unexplained differences between 2020 ceilings in the NERP text and Annex 2*

[56] *Energy Community website, last accessed 29 May 2020.*

[57] *Government of Kosovo, Kosovo National Emissions Reduction Plan, 2018.*

[58] *This alleged instance of non-compliance refers to Articles 4(1) and 4(3) and Parts A of Annexes III, IV, V, VI and VII of Directive 2001/80/EC (the Large Combustion Plants Directive), which establish emission limit values for existing plants, as well as Article 30(3) and Part 2 of Annex V of Directive 2010/75/EU for new plants.*

[59] *Energy Community, Case ECS-08/21: Kosovo / environment, accessed 2 July 2021.*

[60] *'The ceilings for the years 2019 to 2022 shall be set providing a linear trend between the ceilings of 2018 and 2023. In practice, this means that the ceilings will not change between 2018 and 2023 except for NO_x'. Energy Community, Policy Guidelines 03/2014, December 2014.*

Compliance with the NERP ceilings in 2020

For the first time in the three years since reporting emissions became obligatory, Kosovo has submitted its data on time. However, this data is still password-protected on the European Environment Agency's website,[61] as was the case for the previous year's data. The authors of the report obtained the 2020 emissions data based on a request for access to public information submitted by Kosovo partners.

Like Bosnia and Herzegovina, Kosovo breached the ceilings for all three pollutants, by a large margin. The biggest problem remains dust emissions. They were 4.25 times above the ceiling in Annex 2, at 5,867 tonnes, an increase from the 5,042 tonnes emitted in 2018. Kosova B alone breached the national dust ceiling by 3.85 times, releasing a total of 5,314 tonnes of dust into the atmosphere. The B2 unit emitted 6.64 times above its individual ceiling, making it the worst emitter.

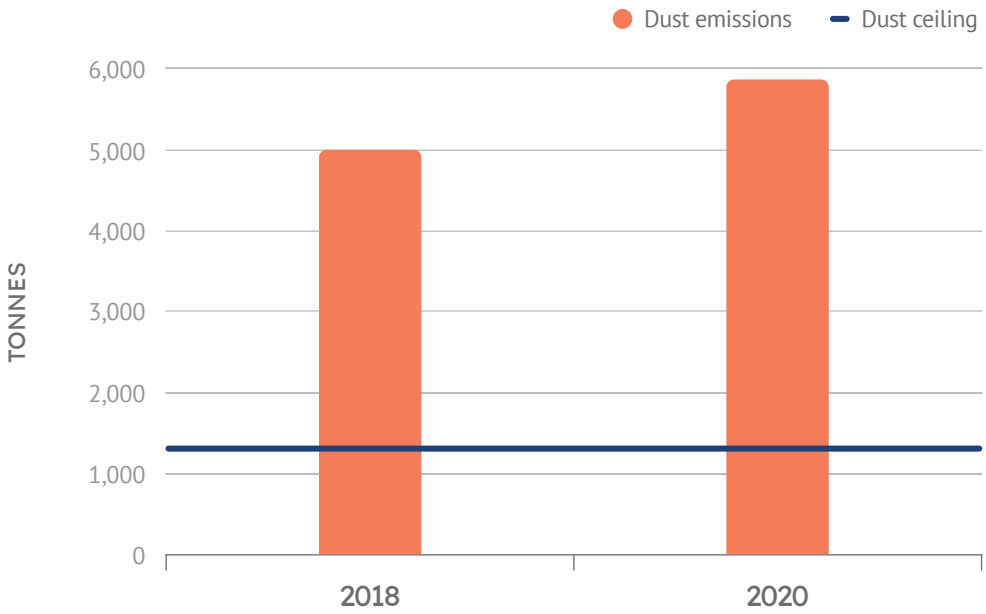

Figure 9: *Dust emissions from Kosovo's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

SO_2 emissions were also 1.8 times above the national ceiling in 2020, at an absolute value of 19,987 tonnes. Again, Kosova B's two units on their own breached the national ceiling, with 13,184 tonnes. SO_2 recorded a considerable increase in emissions compared to 2018, from 14,232 tonnes, despite a comparable number of operating hours. The reasons for the increase are unclear, but may result from a decrease in the quality of lignite (meaning that the coal used in 2020 had a much higher sulphur content), or technical problems in the plants. It could also be the case that a different formula for calculating the emissions was used, considering Kosova A lacks continuous monitoring equipment and Kosova B's monitoring equipment is hardly ever operational.

[61] *European Environment Agency, EIONET Central Data Depository, 16 March 2021.*

Open cast lignite mine, Kosovo
Photo credit: Balkan Green Foundation

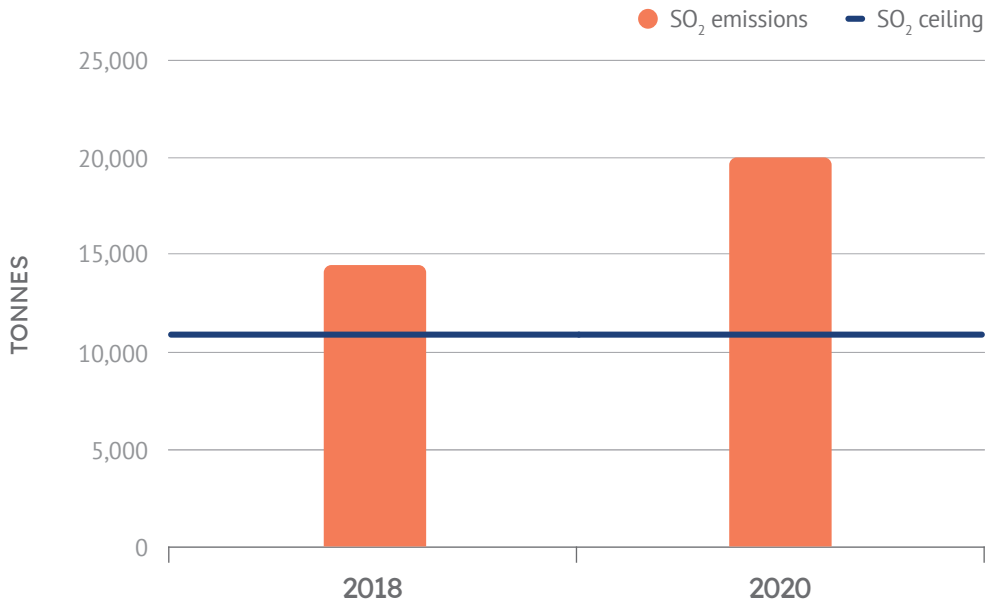

Figure 10: *Sulphur dioxide emissions from Kosovo's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Kosovo's NO_x emissions also significantly increased between 2018 and 2020 – they reached 22,846 tonnes, nearly 3,700 tonnes more than in 2018. The country stands out for the highest breach of the NO_x ceiling – 1.65 times as much as allowed. On an individual unit level, the Kosova A4 unit had the highest breach of its own ceiling, with emissions more than double the limit.

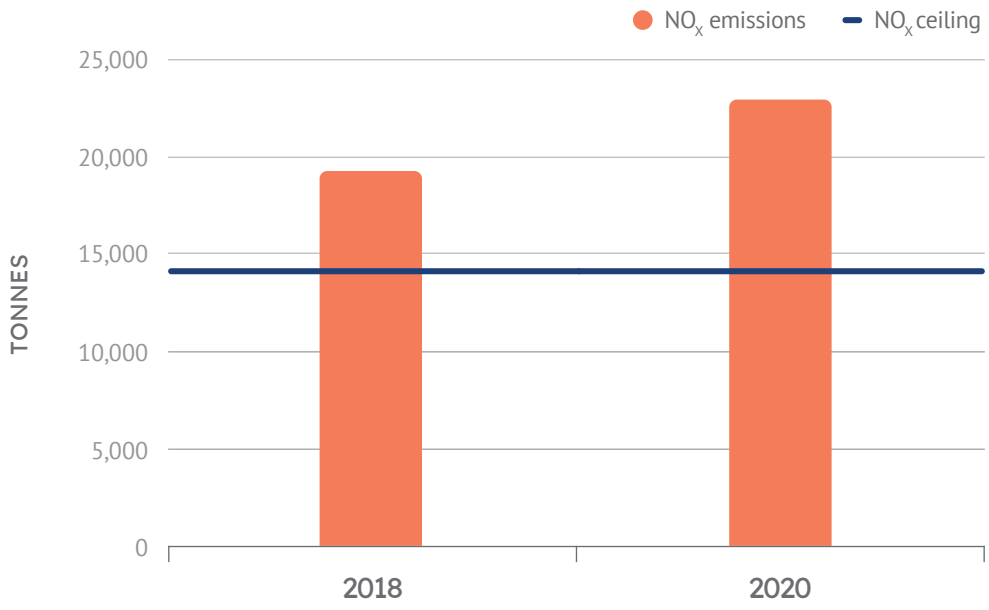

Figure 11: *Nitrogen oxides emissions from Kosovo's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Kosovo (2020)	SO_2 ceiling	SO_2 emissions	Dust ceiling	Dust emissions	NO_x ceiling	NO_x emissions
Main NERP ceiling	10,150	19,987	3,302	5,867	10,239	22,846
Annex 2	11,057		1,382		13,821	

Health impacts

Health impact	Pollutant	Number of cases, 2020	95% confidence interval	Cost (EUR million)	95% confidence interval
Asthma symptoms in asthmatic children	PM_{10}	2,655	575–4,783	0.06	0.01–0.11
Bronchitis in children	PM_{10}	267	0–603	0.08	0–0.19
Cardiovascular hospital admissions	$PM_{2.5}$	35	7–63	0.04	0.01–0.08
Incidence of chronic bronchitis in adults	PM_{10}	64	23–100	2.72	0.97–4.26
Mortality, all causes	all	129	82–174	208.6	132.3–281.2
Respiratory hospital admissions	$PM_{2.5}$	36	0–76	0.04	0–0.09
Restricted activity days	$PM_{2.5}$	146,193	130,956–164,382	4.77	4.28–5.37
Work days lost	$PM_{2.5}$	27,225	23,160–31,263	1.66	1.41–1.90

Table 8: *Total health impacts and related costs due to emissions exceedances of Bosnia and Herzegovina's power plants (NERP), 2020*

Kosovo's two power plants and their emissions exceedances were to blame for over 2,600 days of asthma symptoms in asthmatic children in 2020. Other health impacts included 267 cases of bronchitis in children due to exposure to high levels of PM10, over 70 hospital admissions of cardiovascular and respiratory patients because of PM2.5, and 64 cases of chronic bronchitis in adults alone due to PM10. Mortality, with an estimated 129 deaths, was the impact with the highest costs – EUR 209 million.

The loss of productivity because of restricted activity days and work days lost due to sick leave amounted to EUR 6.4 million.

Ongoing investments

Kosovo's NERP envisages that Kosova B1 will undergo retrofitting by 2021[62] so that its dust and NO_x emissions will be compliant with the Industrial Emissions Directive emission limit values. It also envisages that unit B2 will follow suit and comply by 2022, with the use of a EUR 76.4 million grant under the European Commission's Instrument for Pre-Accession II (IPA II) signed in November 2019. However, at the official launch of the rehabilitation works in January 2020, it was stated that the retrofit of Kosova B would be finalised in three years.[63] Even this timeline may be pushed back, taking into account a decision[64] of the European Court of Justice regarding a complaint submitted by one of the bidders for the rehabilitation project who was initially excluded from the tender in July 2019, which may lead to a re-run of the tender.

Apart from this ongoing project at Kosova B, no information is publicly available regarding the government's intentions to reduce sulphur emissions, which all existing units are in desperate need of. Considering the experience with Kostolac B and Ugljevik's desulphurisation equipment installation, it is becoming less and less likely that Kosovo will comply with SO_2 emission limit values at the end of 2027, even if such a project starts in the very near future. Still, the power plants' operator's webpage[65] states that the company's objectives are to increase the life expectancy of Kosova B by 20 years, following the retrofit, as well as conducting a feasibility study for the Kosova A power plant, which would determine its future.

62 *Government of Kosovo, Kosovo National Emissions Reduction Plan, 11, 2018.*

63 *Vladimir Spasić, 'KEK starts EU-funded project to reduce air pollution from TPP Kosovo B', Balkan Green Energy News, 31 January 2020.*

64 *Verdict of the General Court (first chamber), Javna nabava – Postupak javne nabave – Smanjenje prašine i dušikovih oksida iz jedinica B1 i B2 termoelektrane Kosovo B – Odbijanje zahtjeva za sudjelovanje – Zahtjev za poništenje postavljen u replici – Novi tužbeni zahtjev – Očita nedopuštenost – Izmjena kriterija za odabir tijekom postupka – Jednako postupanje, U predmetu T-525/19, 21 April 2021.*

65 *Kosovo Energy Corporation (KEK), Prodhim rekord në historinë e KEK-ut, 19 January 2021.*

Montenegro

Pljevlja coal plant exceeds its permitted operating hours

Until 2020, Montenegro was the only country in the region[66] that stood a chance of maintaining compliance with the Large Combustion Plants Directive. However, the situation has changed rapidly and **in April 2021 the Energy Community Secretariat opened an infringement case against Montenegro**.[67]

The 225 MWe Pljevlja I lignite power plant has only one unit, and thus could not be subject to a National Emissions Reduction Plan. Since the plant generates around 40 per cent of Montenegro's electricity, depending on the year, closing it looked unattractive. Instead of making sure it was LCPD-compliant by 2018, the government and the plant's operator Elektroprivreda Crne Gore (EPCG) lost several years concentrating on the construction of the now-cancelled Pljevlja II, and did not pay sufficient attention to resolving Pljevlja I's pollution issues.

Therefore, the 'opt-out' option was chosen, in which Pljevlja I would be able to operate for a total of 20,000 hours between 1 January 2018 and 31 December 2023. After that, it either has to close or to undergo a retrofit that would bring it into compliance with emission limit values for new plants, not existing ones.

In March 2018, Montenegro's Environmental Protection Agency finally issued the Pljevlja I plant with an integrated environmental permit,[68] which stipulated that it must comply with the 2017 EU LCP BREF standards by 2023. As such, it is the first existing plant in the region which has been required to do so.

However, instead of spreading the available 20,000 hours evenly over the whole period from 2018 to 2023, the management of EPCG used them up as quickly as possible. The Pljevlja coal plant operated for 7,194 hours in 2020.[69] Combined with the operating hours for 2018 and 2019, which amounted to 13,809 hours in total, this brings the plant well beyond the 20,000 hours allowed under its opt-out regime.

After 30 years of the same ruling party, a new government took office in Montenegro in December 2020, and one of the first things that awaited them was the issue of what to do with the Pljevlja coal plant. It was already suspected by that point that it had used up all its hours, but this had not yet been confirmed, and EPCG was less than cooperative in clarifying the situation.[70] Only in March 2021 when Montenegro had to report its operating data to the European Environment Agency under the Energy Community Treaty was the breach confirmed, yet the plant has continued to operate.

Emissions in 2020

Pljevlja's sulphur dioxide emissions amounted to 63,922 tonnes in 2020 – similar to its total for 2018 and much higher than 2019. The reason for these large variations is unclear, and they are not fully accounted for by differences in operating hours in the different years.

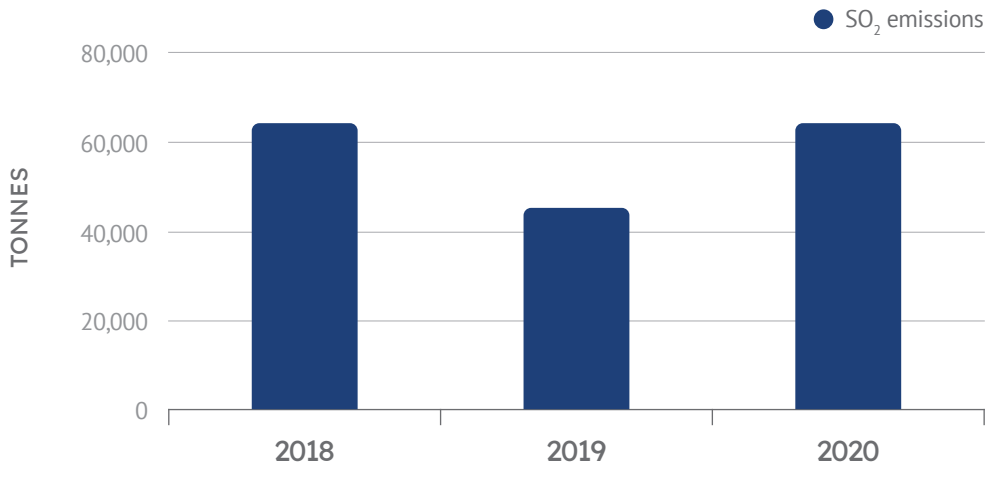

Figure 12: *Sulphur dioxide emissions from Montenegro's Pljevlja coal plant, 2018 to 2020*

[66] *Apart from Albania, which has no functional large combustion plants*

[67] *Energy Community Secretariat, Secretariat launches dispute settlement procedure against Montenegro for breaching Large Combustion Plants Directive as TPP Pljevlja exhausts 'opt-out', 20 April 2021.*

[68] *Environmental Protection Agency of Montenegro website, last accessed 24 May 2021. The permit is no longer online; only the list of measures to be taken is still available online, but the announcement about the permit is still up.*

[69] *European Environment Agency, EIONET, Central Data Repository, reported 26 March 2021.*

[70] *Vijesti Online, Boje Jutra - Budućnost termoelektrane Pljevlja - Diana Miley Čavor, Marko Perunović, YouTube, 23 February 2021.*

Pljevlja, Montenegro
Photo credit: RTV Pljevlja (for Green Home)

NO_x emissions decreased significantly between 2018 and 2020 but are still very high. Emissions in 2020 were comparable to those of Kostolac B1 and B2 – a plant three times larger than Pljevlja.

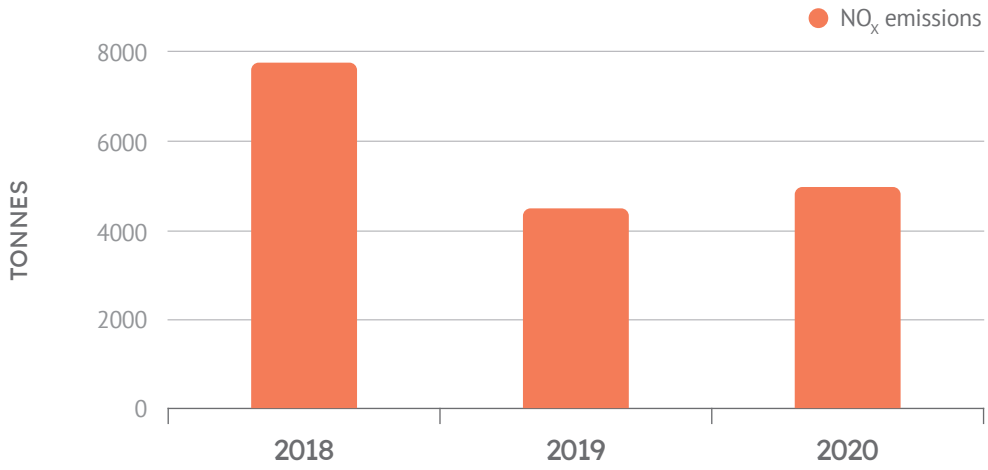

Figure 13: *Nitrogen oxides emissions from Montenegro's Pljevlja coal plant, 2018 to 2020*

Meanwhile, Pljevlja's dust emissions increased, rather than decreased, between 2018 and 2020.

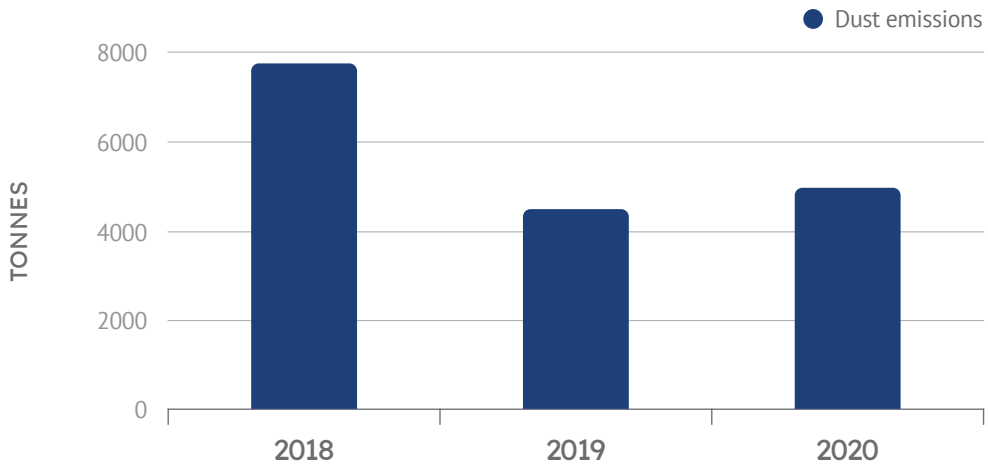

Figure 14: *Dust emissions from Montenegro's Pljevlja coal plant, 2018 to 2020*

Health impacts

Health impact	Pollutant	Number of cases, 2020	95% confidence interval	Cost (EUR million)	95% confidence interval
Asthma symptoms in asthmatic children	PM_{10}	12,257	2,655–22,078	0.32	0.07–0.57
Bronchitis in children	PM_{10}	1,162	0–2,626	0.40	0–0.91
Cardiovascular hospital admissions	$PM_{2.5}$	220	41–399	0.29	0.05–0.53
Incidence of chronic bronchitis in adults	PM_{10}	316	112–494	16.2	5.73–25.3
Mortality, all causes	all	625	407–830	1,276.0	830.0–1,694.1
Respiratory hospital admissions	$PM_{2.5}$	218	0–457	0.28	0–0.59
Restricted activity days	$PM_{2.5}$	911,655	816,637–1,025,079	35.9	32.1–40.3
Work days lost	$PM_{2.5}$	181,260	154,197–208,142	15.4	13.1–17.7

Table 9: *Health impacts and related costs due to total emissions of Montenegro's power plant Pljevlja (opt-out), 2020*

As a result of the Pljevlja plant's emissions, over EUR 1.3 billion were incurred in health costs by Montenegro and other countries. The estimated 625 deaths in 2020 make up almost 95 per cent of these costs, whilst the estimated 1,162 bronchitis cases in children due to PM10 amount to just over EUR 0.4 million.

Over 1 million restricted activity or lost work days are estimated, costing Montenegro's and other countries' economies EUR 51.3 million. In 2020, there were an estimated 12,257 days of asthma symptoms in asthmatic children, and a total of 436 cardiovascular and respiratory hospital admissions.

Ongoing investments

In June 2020 Montenegro's previous government signed a contract with a consortium led by China's Dongfang (DEC International) to retrofit the plant to bring it in line with the EU's 2017 LCP BREF.[71]

However, EPCG has never publicly proven[72] that such an investment would be economically justified, nor that the planned investments would be technically capable of bringing the plant into compliance. At the time of signing, it was also claimed that this investment would extend the lifetime of the plant by 30 years, which seems highly unlikely. The plant is too old to operate for so long in its current state, but the planned works do not include reconstruction of the main parts of the plant, such as the boiler.

The prices for the bids for the modernisation varied very widely, leading both the media and one of the competing bidders, Hamon Rudis, to question[73] whether the winning bid offers an inferior technological solution. Hamon Rudis requested that the selection commission check the compliance of Dongfang's bid with the technical specifications in the tender documentation due to its much lower price than the other two bids.

[71] *Balkan Green Energy News, 'EPCG signs agreement on TPP Pljevlja environmental overhaul', Balkan Green Energy News, 10 June 2020.*

[72] *Goran Malidžan, 'Eko-tim: Objaviti studiju ekonomske opravdanosti ekološke rekonstrukcije TE Pljevlja', Vijesti, 24 July 2020.*

[73] *Tender commission, Minutes of opening the bids, 11 July 2019.*

The Decision[74] on the selection of the best bid responded that no specification was included in the tender obliging the bidders to submit technical documentation – they only had to provide statements that their offer complied with certain parameters. It is therefore, conveniently, impossible to check the technical specifications of each bid. This leaves very little information on which to assess the technical quality of the winning bid and raises serious doubts as to the quality of the project.

Another issue is that the winning consortium includes BB Solar, a company half-owned[75] by the president of Montenegro's son, Blažo Đukanović, which, as the name suggests, specialises in solar rather than coal plants.

Therefore, **in early April 2021, the Ministry for Capital Investments asked the public prosecutor to investigate the tender process,** as well as the fact that EPCG used up all its hours in three years instead of spreading them out until the modernisation project was ready to start.[76] As of late May 2021, it remains to be seen whether the modernisation will take place at all, but the government has made clear its stance that the plant should continue to operate.[77]

North Macedonia

Compliance with the NERP ceilings in 2020

North Macedonia adopted its NERP in 2017 without any public consultations or a Strategic Environmental Assessment. It includes all eight existing large combustion plants from the energy sector.[78] Out of these, three have not been operational since the NERP went into force, and two are gas-fired heating plants that were already in line with the 2017 LCP BREF.

Therefore, the Bitola and Oslomej coal-fired power plants are the only large combustion plants that are relevant for compliance with the country's NERP, and also the only ones that needed to install pollution control equipment. However, because they have failed to do so, these three stacks are breaching the national SO_2 and dust ceilings for the third year in a row.

North Macedonia (2020)

SO_2 ceiling	SO_2 emissions	Dust ceiling	Dust emissions	NO_X ceiling	NO_X emissions
15,855	86,700	1,738	3,684	12,672	4,057

Just as in 2019, reported emissions for 2020 again show extremely high SO_2 emissions. The three coal-fired large combustion plants emitted 86,700 tonnes of SO_2, which is almost 5.5 times above the national ceiling of 15,855 tonnes.

The two stacks of the Bitola power plant, Bitola B1+B2 (60,422 tonnes) and Bitola B3 (24,091 tonnes), remain the biggest source of SO_2 emissions in the country. Emissions are somewhat lower than those in 2019, but that is only because of the lower number of operating hours. The 60,422 tonnes from Bitola B1+B2 are again among the highest in the region and are more than nine times as high as the plant's individual ceiling of 6,585 tonnes. Bitola B3's emissions are also 8.5 times higher than the 2,859-tonne individual ceiling.

Oslomej's contribution is only 2,164 tonnes of SO_2, half of the plant's individual ceiling, but all of these emissions were released during the two winter months when the plant was operational.

[74] *Elektroprivreda Crna Gora, Decision on the best bid, 7 November 2019.*

[75] *Montenegro Ministry of Finance, Central Register of Economic Entities, accessed 2 July 2021.*

[76] *Biljana Matijašević, 'Milioni za Termoelektranu u Specijalnom tužilaštvu', Vijesti, 3 April 2021.*

[77] *Goran Kapor, 'Obustaviti postupak revizije da TE Pljevlja ne bi prestala sa radom 1. Juna', Vijesti, 13 May 2021.*

[78] *Energy Community decision D/2013/05/MC-En – '"[E]xisting plant" means any combustion plant for which the original construction licence or, in the absence of such a procedure, the original operating licence was granted before 1 July 1992.'*

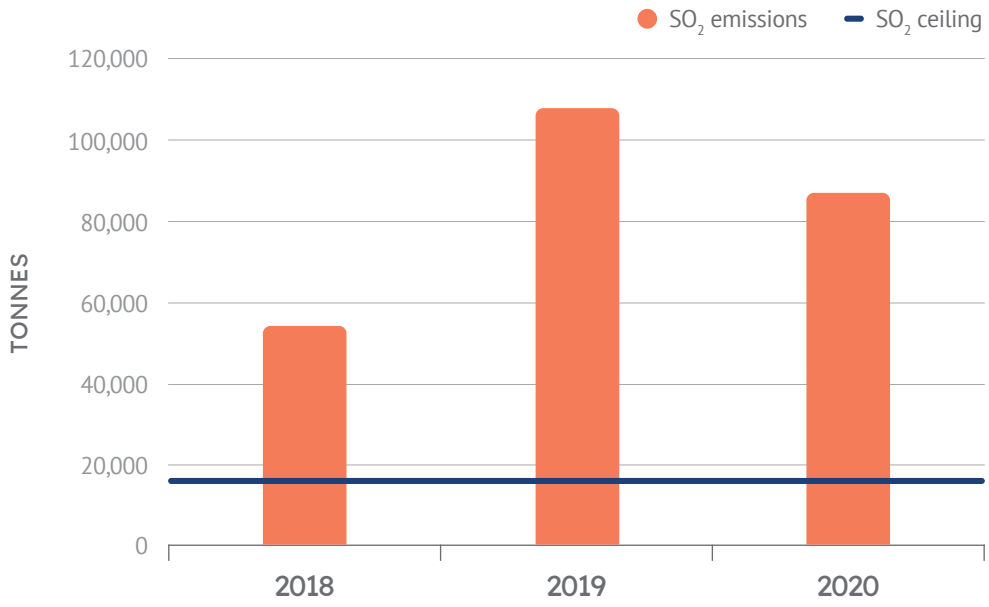

Figure 15: *Sulphur dioxide emissions from North Macedonia's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Dust emissions in 2020 remained at almost the same level as those in 2018 and 2019, still more than double than the national ceiling. The Bitola B1+B2 stack was the highest emitter, with 2,688 tonnes of dust – single handedly breaching the national ceiling of 1,736 tonnes. Bitola B3 added 784 tonnes and Oslomej 212 tonnes of dust emissions.

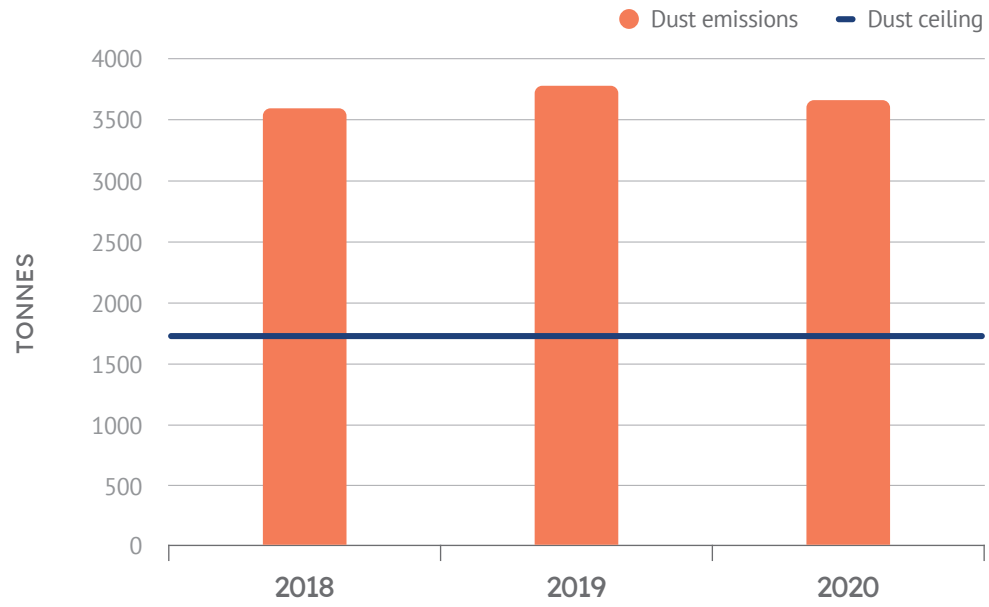

Figure 16: *Dust emissions from North Macedonia's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Coal power plants emitted 4,057 tonnes of NO_x, which was significantly lower than the unrealistically high national ceiling. These emissions are even lower than the 2027 ceiling of 6,179 tonnes, which will be in effect at the end of the NERP periods. Unit 1 from the Bitola power plant has not yet been refurbished to reduce NO_x emissions and having the ceiling set like this allows for it to remain non-LCPD-compliant even after 2027. The objective is to have all plants individually compliant with the Industrial Emissions Directive Annex V requirements after 2027, and this ceiling is not in line with this objective.

Health impacts

Health impact	Pollutant	Number of cases, 2020	95% confidence interval	Cost (EUR million)	95% confidence interval
Asthma symptoms in asthmatic children	PM_{10}	6,290	1,363-11,331	0.2	0.03–0.28
Bronchitis in children	PM_{10}	594	0–1,342	0.12	0–0.45
Cardiovascular hospital admissions	$PM_{2.5}$	104	20–189	0.14	0.03–0.25
Incidence of chronic bronchitis in adults	PM_{10}	145	51–227	7.03	2.49–11
Mortality, all causes	all	294	192–390	567.8	370.1–753.1
Respiratory hospital admissions	$PM_{2.5}$	108	0–226	0.14	0–0.29
Restricted activity days	$PM_{2.5}$	441,301	395,306–496,206	16.4	14.7–18.5
Work days lost	$PM_{2.5}$	74,349	63,248–85,375	6.0	5.11–6.89

Table 10: *Health impacts and related costs due to emissions exceedances of North Macedonia's power plants (NERP), 2020*

The Bitola power plant is among the region's most dangerous power plants with respect to the health impacts it causes. If Bitola had complied with its emissions ceilings, it would have avoided almost 300 deaths in North Macedonia and other countries in 2020. There were 6,290 recorded days of asthma symptoms in asthmatic children in 2020 and 594 cases of bronchitis in children in 2020 `A total of 74,349 work days were lost due to sick leave caused by the pollutant PM2.5 in 2020, costing the modelled countries' economies EUR 6 million. In 2020 there were an estimated 212 cardiovascular and respiratory hospital admissions due to PM2.5 from the emissions breaches, costing a total of EUR 0.28 million.

Bitola power plant, North Macedonia

Ongoing investments

In 2019 a failed tender was held for the reconstruction of the electrostatic precipitator in Bitola, and fruitless public consultations took place for the integrated pollution prevention and control (IPPC) permit for the plant. At the time of writing in June 2021, no permit has been issued. Since 2019, there have been no efforts to improve pollution control at any of the coal-fired power plants. The main reason for this is the uncertainty surrounding their future arising from the several strategic documents that were under preparation from mid-2019 until June 2021.

The Energy Strategy 2020-2040, which was adopted by the government in December 2019, introduced a problematic approach to the future of the coal-fired power plants. The investments necessary for compliance of the plants with environmental regulations were considered an option dependent on which scenario was selected, which in theory made sense, but only if the government had quickly made a concrete decision to follow a specific scenario. The Oslomej plant would be decommissioned in all scenarios, but Bitola would continue working in the reference (business as usual) scenario of the Strategy and would be decommissioned because of the introduction of a CO_2 tax in the moderate transition and green scenarios. Accordingly, pollution control investments are considered only in the reference scenario and they are excluded in the moderate and green scenarios because they are deemed not to be financially viable.

This approach was then copied in the National Energy and Climate Plan and the Programme for the Implementation of the Energy Strategy. These documents further developed the green scenario as the least-cost and least environmentally damaging option and recommended that Oslomej be decommissioned in 2021 and Bitola in 2027. However, this means that Bitola is given the green light to work without pollution control and continue polluting in the next six years, and to avoid compliance with environmental regulations as long as it is planned for decommissioning.

Not only does condoning such breaches aggravate the health impacts of coal, but it also allows the strategic planning of the energy sector to circumvent environmental legislation, creating a dangerous precedent for future strategies. **The coal-fired plants in the country are already allowed to work illegally, without IPPC permits and without meeting basic environmental requirements**, such as continuous monitoring of emissions, and this approach implicitly condones their illegal operation.

The Bitola phase-out is also linked to a number of preconditions, like the introduction of a CO_2 tax, and the construction of several larger gas-fired and hydropower capacities that will replace Bitola's role in the energy sector. This may cause further delays in its closure. The six-year period might also turn out to be much longer, causing several more years of environmentally damaging operations.

Serbia

State of play with the NERP

Serbia's entire process for approval and adoption of its NERP was marked by a lack of transparency and several contradictions. It took an infringement procedure by the Energy Community Secretariat for Serbia to finally adopt the document, five years after it was first written.

In February 2020, the Ministry of Environment finally adopted the NERP,[79] but the Serbian non-governmental organisation the Renewables and Environmental Regulatory Institute (RERI) has warned that the fact that the plan wasn't approved through one of the legally stipulated formats, such as a Decision or Decree, means that it may be unenforceable due to the lack of legal framework governing such documents.[80]

[79] *Ministry for Environmental Protection, Nacionalni plan za smanjenje emisija glavnih zagađujućih materija koje poticu iz starih velikih postrojenje za sagorevanje, 13 February 2020.*

[80] *Renewables and Environmental Regulatory Institute (RERI), Kako zakasnelo (ne)usvajanje NERP-a utiče na zagađenje vazduha?, February 2020.*

Nikola Tesla A power plant, Serbia

Adding to the delay in adoption, the new document also mentions delays for two of the deadlines for implementing sulphur oxides emission reduction measures (for Nikola Tesla units A3 and A4-A6), from 2020 to 2022 and 2021, respectively. The decision to delay these retrofits was unilaterally decided by the Ministry of Environment. Therefore, the currently adopted NERP no longer corresponds to the version that the Energy Community Secretariat approved in 2017.

In January 2021, RERI took legal action against Serbia's state-owned electricity company Elektroprivreda Srbije (EPS) for exposing Serbian and EU citizens to toxic gases six times above the legal limit, in breach of both national and international law. The complaint was based on SO_2 emissions in 2018 and 2019, which stood at six times above the national ceiling.

Compliance with the NERP ceilings in 2020

Emissions from coal power plants in Serbia far exceeded the 2020 ceilings set out in the NERP. The breach is even higher than in the two previous years, as quite a few of the units' emissions have increased compared to 2019 and 2018.

The biggest problem remains SO_2 emissions, which were 6.1 times as high as the national ceiling, significantly higher than in 2019 when they were 5.6 times as high. In absolute numbers, the SO_2 emissions of the 14 coal-fired units included in the NERP amounted to 333,602.29 tonnes, while the 2020 ceiling in the NERP for 18 large combustion plants[81] is set at a maximum of 54,575.33 tonnes. This is a significant increase from 305,306.90 tonnes in 2019.

On the plant level, the biggest emitters were Kostolac B, whose SO_2 emissions alone breached the national 2020 ceiling 1.74 times at a soaring 95,096.75 tonnes, followed closely by Nikola Tesla B1 and B2, which emitted 85,765.9 tonnes.[82]

Kostolac B1 and B2 are in danger of being a failed investment in pollution control, as the power plant underwent a rehabilitation process and in 2017 the installation of desulphurisation equipment by the China Machinery Engineering Corporation was allegedly finalised and put into operation.[83] **Kostolac B is the only power plant in Serbia to have installed flue-gas desulphurisation (FGD) equipment, and yet it breached its 2020 individual SO_2 ceiling in the NERP by nearly 12 times!** The breach for the previous year was nearly 10 times, a huge increase considering the plant operated for only approximately 100 hours more than in 2019.

Kostolac B is therefore the country's biggest SO_2 polluter, both in terms of the breach of its individual ceiling as well as the total volume of pollution spewed through its stack.

A notable continuous increase in the amount of SO_2 emitted annually can be seen also at the Nikola Tesla A power plant. Units A1-A3 emitted 43,342.36 tonnes in 2020, compared to 35,680.9 in 2018 and 36,471.5 in 2019, while Units A4-A6 emitted 25 per cent more in 2020 than in 2018 when LCPD entered into force. The number of operating hours has had minor variation over the three years. Nikola Tesla units A1-A3 and A4-A6 breached their individual ceilings over five times each, and together they emitted twice as much as the 2020 national ceiling.

[81] *The NERP also includes gas-fired units, such as those owned by NIS in Novi Sad and Pančevo, as well as a refinery. Ministry for Environmental Protection, Nacionalni plan za smanjenje emisija glavnih zagađujućih materija koje poticu iz starih velikih postrojenje za sagorevanje, Annex 2, February 2020.*

[82] *European Environment Agency, EIONET Central Data Repository, report version 30 March 2021. Data not yet verified by the European Environment Agency.*

[83] *Sandra Jovićević, 'Blokovi B1 i B2 u Kostolcu dobili postrojenja za odsumporavanje', Energetski portal, 18 July 2017.*

Figure 17: *Sulphur dioxide emissions from Serbia's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Dust emissions are within the national ceiling; however, Nikola Tesla's A1-A3 units breached their individual ceiling by nearly 2 times, emitting 1,984.10 tonnes, compared to the ceiling of 1,031.79. Kostolac B emitted 69 tonnes above its own ceiling, and Kostolac A 18, but the other units' dust emissions were significantly lower than their individual ceilings, allowing Serbia to comply with the national level ceiling.

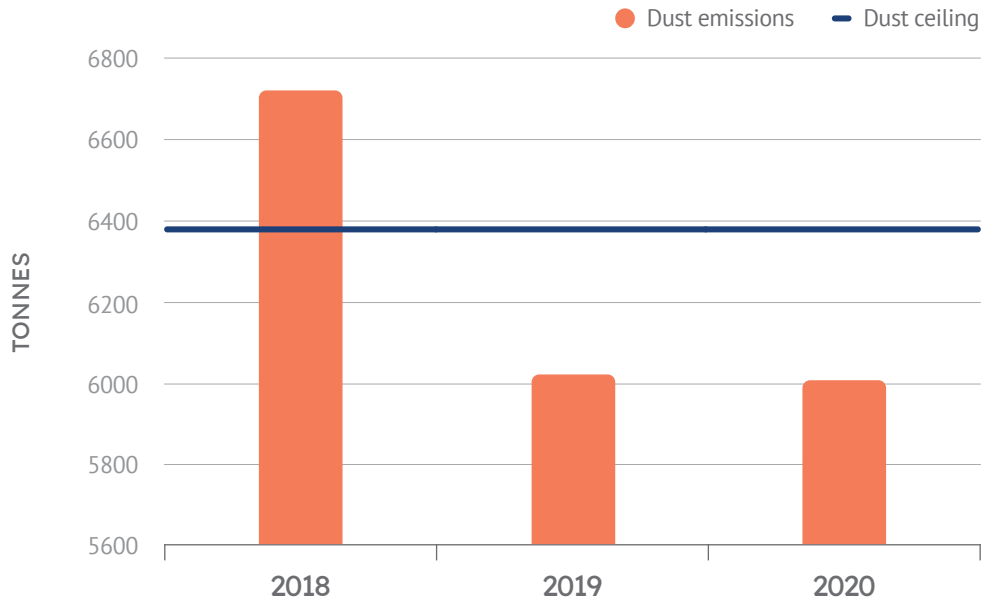

Figure 18: *Dust emissions from Serbia's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Nitrogen oxide (NO_x) emissions in Serbia in 2020 stood at 76 per cent of the ceiling in the NERP, even though Kostolac A2 emitted 47 tonnes above its ceiling. Although the current emissions are compliant with the ceiling, the latter will continue to decrease year by year, and if no measures are currently being considered for NO_x reduction, we can expect breaches of NO_x emissions as soon as 2022.

Serbia (2020)

SO_2 ceiling	SO_2 emissions	Dust ceiling	Dust emissions	NO_x ceiling	NO_x emissions
54,575.33	333,602.29	6,390.32	6,009.53	48,241.56	36,432.30

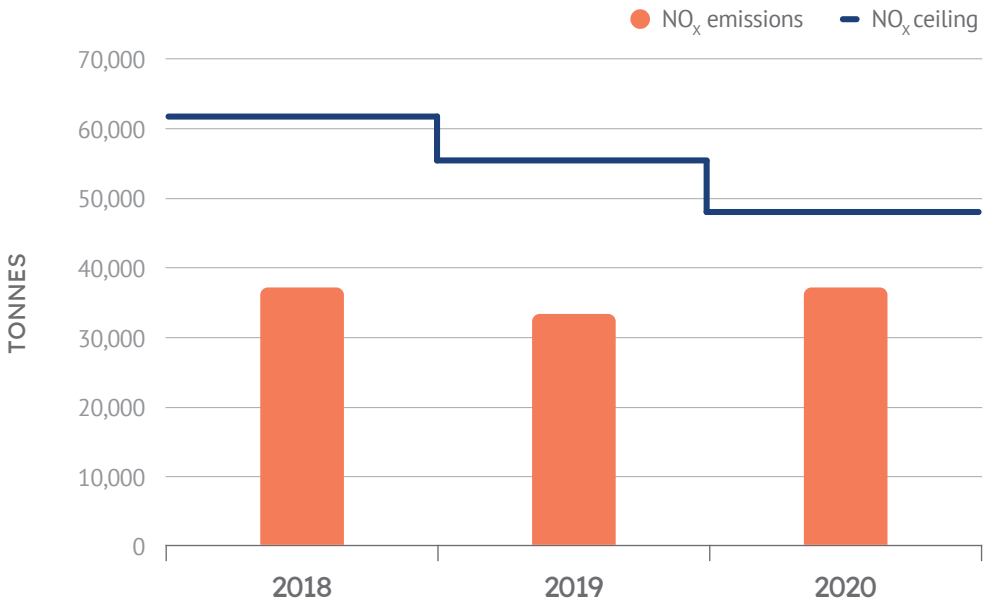

Figure 19: *Nitrogen oxides emissions from Serbia's NERP coal plants, compared to the allowed emissions ceilings, 2018 to 2020*

Health impacts

Health impact	Pollutant	Number of cases, 2020	95% confidence interval	Cost (EUR million)	95% confidence interval
Asthma symptoms in asthmatic children	PM_{10}	42,752	9,261-77,007	1.08	0.23–1.95
Bronchitis in children	PM_{10}	4,077	0-9,215	1.39	0–3.15
Cardiovascular hospital admissions	$PM_{2.5}$	847	159-1,539	1.12	0.21-2.04
Incidence of chronic bronchitis in adults	PM_{10}	1,139	404-1,782	59.7	21.2–93.4
Mortality, all causes	all	2,326	1,516-3,086	4,907.4	3,197.9–6,509.2
Respiratory hospital admissions	$PM_{2.5}$	848	0-1,776	1.09	0-2.28
Restricted activity days	$PM_{2.5}$	3,338,666	2,990,691- 3,754,051	135.8	121.6–152.7
Work days lost	$PM_{2.5}$	666,939	567,363- 765,851	58.7	49.9–67.4

Table 11: *Total health impacts and costs due to emissions exceedances of Serbia's power plants (NERP), 2020*

In 2020, there were an estimated 847 cardiovascular hospital admissions due to PM2.5 emissions from the NERP coal plants, costing not only Serbia but other countries a total EUR 1.12 million. Health impacts included an estimated 42,752 days of asthma symptoms in asthmatic children due to PM10 and 4,077 cases of bronchitis in children due to the same pollutant.

The plants are associated with over 3.3 million restricted activity days and lost days – costing Serbia's and other countries' economies a total of EUR 135.8 million in 2020. Two thousand three hundred and twenty-six deaths due to all pollutant exceedances cost a total of almost EUR 5 billion, and incidences of bronchitis in adults cost EUR 59.7 million in 2020.

Ongoing investments

Serbia's energy utility EPS secured financing for a complete overhaul of Kostolac B1 and B2 in December 2011. A USD 293 million loan was taken by the Government of Serbia on behalf of EPS from China Exim Bank to equip the two units with flue gas desulphurisation technology and bring the plant's SO_2 emissions in line with the Large Combustion Plant Directive[84] by the time the Directive would enter into force in January 2018. The company contracted for the works was the China Machinery and Engineering Corporation (CMEC), the same company which is set to build a new unit at Kostolac B.

The works were finalised in July 2017, according to media reports.[85] However, EPS' 2018 Environmental Report shows that the application for a construction permit for the FGD installation was submitted only in November 2018 – more than a year after the opening ceremony for the facility. The permit had still not been issued at the time of writing, but was actually rejected twice – one in December 2018 and one in January 2019 – although the grounds on which rejections were issued by the Serbian authority are unknown.

The only explanation we have received so far from EPS and the Serbian Ministry of Energy and Mining is that the gypsum landfill[86] is not ready for the de-SO_x to start operation. A member of Serbia's Parliament publicly asked about the situation with the permit[87] due to increasing levels of air pollution in the country at the time, prompting the power plant's operator EPS to put the de-SO_x into operation in October 2020.

In April 2021, the Ministry of Mining and Energy announced[88] that in fact the facility has been operating in testing mode since October 2020. Without access to monthly continuous monitoring data on emissions, it is difficult to verify this information. Even if only in the testing phase, a decrease in emissions should have already been recorded from October onwards, but the fact that annual emissions in 2020 were much higher than those in the previous year casts doubt on the Ministry's triumphant statement.

In December 2019, EPS launched a public consultation for an 'updated' Environmental Impact Assessment (EIA) report for the desulphurisation unit at Kostolac B,[89] and public consultations were held in January 2020. The decision approving this new EIA for the already built de-SO_x facility was made in August 2020.[90]

The fact that SO_2 emissions have increased in comparison to those in 2019 reinforces doubts about this investment: what is wrong, and why does it take so long to fix? Almost four years after it was declared finalised, the public has received almost no information about the equipment's lack of functionality. Such information should not be withheld from the public, who ultimately pays the costs – both financial and health-related.

At Kostolac A, a bid for the feasibility of constructing a desulphurisation installation was launched[91] by EPS in October 2020. The intention of the operator is also to expand the power plant's lifetime by an additional 15 years.[92] This seems highly unrealistic, considering that Kostolac A1 is among the oldest units in the region – 54 years old – and A2 has also operated for over 40 years. In fact, initially the two units were to be closed by 2023 the latest, but they were later included in the NERP, which allows them to continue operating until the end of 2027.

[84] *Only approximately USD 130 million was intended for the de-SOx equipment, and the rest of the loan was for the construction of transport infrastructure facilities – a landing dock on the Danube and railway infrastructure for transportation of gypsum and ash. Serbia Energy/Environment southeast Europe, Serbia: 130M USD Project of desulphurization in "Kostolac B", with works to the contemporary block, China CMEC as key contractor the project report, 2 July 2021.*

[85] *Sandra Jovićević, 'Blokovi B1 i B2 u Kostolcu dobili postrojenja za odsumporavanje'.*

[86] *Gypsum is a by-product of desulphurisation that needs to be used or disposed of.*

[87] *Beta, 'Tepić: Da li je izdata dozvola za postrojenje za odsumporavanje u TE "Kostolac"', N1, 19 October 2020.*

[88] *Beta, 'Ministarstvo: Emisije sumpordioksida u Kostolcu B u okviru propisanih vrednosti', N1, 30 April 2021.*

[89] *Ministry for Environmental Protection, Zahtev za davanje saglasnosti na ažuriranu studiju o proceni uticaja na životnu sredinu projekta izgradnje postrojenja za odsumporavanje dimnih gasova TE Kostolac B na katastarskoj parceli broj 303-k, 16 December 2019.*

[90] *Serbia Ministry for Environmental Protection, Rešenje o davanju saglasnosti nosiocu projekta JP Elektroprivreda Srbije Beograd, na ažuriranu Studiju o proceni uticaja na životnu sredinu projekta izgradnje postrojenja za odsumporavanje dimnih gasova TE Kostolac B, na katastarskoj parceli broj 303 KO Kostolac selo, 28 August 2020.*

[91] *Nina Domazet, 'EPS namjerava produžiti život TE Kostolac A', energetika-net, 19 October 2020.*

[92] *Vladimir Spasić, 'EPS plans to extend lifespan of TPP Kostolac A until 2038', Balkan Green Energy News, 15 October 2020.*

The Programme for the Implementation of the Energy Strategy of Serbia covering 2017 to 2023 states that:

> ***the preparation of investment and technical documentation for [the] status of location TE Kostolac A is on-going. Preliminary analysis shows that thermal block A1 should be withdrawn from operation, and block A2 should be reconstructed with the application of measures to protect the environment, with the necessary investment of 187 million €.***

There is no public information regarding the source of this funding, and it is highly questionable whether A1 should be considered for rehabilitation.

Nikola Tesla units A3-A6 have also been considered for retrofits and the fitting of desulphurisation equipment since 2011. This project, however, moved at a slower pace than Kostolac B1 and B2, and the beginning of works was only announced in 2019.[93] In breach of Serbian law, this announcement came more than a month before the EIA decision was issued[94] by the Ministry of the Environment. This project is financed through a loan from the Japan International Cooperation Agency (JICA),[95] and the contractor is Mitsubishi Hitachi Power Systems. According to the financing agency, the rehabilitation should be finalised by 2022, which explains the adjustment in the adopted version of the NERP from 2020 to 2022, but does not make it more acceptable.

The fitting of desulphurisation equipment at Nikola Tesla units B1 and B2 – the country's second highest SO_2 emitter after Kostolac B – was announced in December 2020,[96] and should be finalised by 2024. The contractor selected for the work is also Mitsubishi Power,[97] and the cost is EUR 210 million. The source of financing for the project is not clear. Even though one would expect this to be covered by a loan from Japan's International Cooperation Agency, as in the case of Nikola Tesla A or Ugljevik, the Agency's annual report for 2020 makes no such mention.[98] To avoid delays and technical difficulties such as those encountered by the same contractor at Bosnia and Herzegovina's Ugljevik power plant, proper quality control and transparency about the stages of the project's realisation will be needed.

In its 2019 Annual Environmental Report,[99] the power plant operator also mentioned that there is a plan to introduce primary nitrogen oxides reduction measures in the coming period for Nikola Tesla units A6, B1 and B2, but no clear indication of a timeline has been offered since then.

Nikola Tesla A power plant, Serbia

93 *Svetlana Jovanović, 'Construction launched on flue-gas desulfurization systems at coal-fired power plant TENT A', Balkan Green Energy News, 14 February 2019.*

94 *Ministry for Environmental Protection: Rešenje o davanju saglasnosti na studiju o proceni uticaja na životnu sredinu projekta izgradnje postrojenja za odsumporavanje dimnih gasova blokova A3-A6 na lokaciji TE Nikola Tesla A, Gradska opština Obrenovac, 29 March 2019.*

95 *Japan International Cooperation Agency, Flue Gas Desulphurization Construction Project for Thermal Power Plant Nikola Tesla, last accessed 29 May 2020.*

96 *Vladimir Spasić, 'SO_2 emissions from Nikola Tesla B coal plant to be reduced 20 times by 2024', Balkan Green Energy News, 2 December 2020.*

97 *Mitsubishi Heavy Industries, Mitsubishi Power Receives Follow-up Order from Serbia for Two Sets of World's Largest Flue Gas Desulfurization Systems -- For Installation at 1,340 MW Nikola Tesla B Coal-fired Power Plant, 22 October 2020.*

98 *Japan International Cooperation Agency, Activities in Serbia, accessed 2 July 2021.*

99 *Electric Power Industry of Serbia, 2019 Environmental Report, 71, May 2020.*

Conclusions and recommendations

As part of their obligations under the Energy Community Treaty, four Western Balkan countries – Bosnia and Herzegovina, Kosovo, North Macedonia and Serbia – have drawn up NERPs covering the period from 2018 to 2027.

Instead of each large combustion plant complying with the emission limit values from the Large Combustion Plants Directive starting on 1 January 2018, these plans allow governments to calculate national emission ceilings for sulphur dioxide, nitrogen oxides and dust, and to gradually decrease the plants' total emissions over the period until 2027. At this point, all plants will individually need to be in compliance not only with the emission limit values from the Large Combustion Plants Directive, but also with Part 1 of Annex V to Directive 2010/75/EU on Industrial Emissions.

However, despite having committed to apply the Large Combustion Plants Directive in 2005, none of these four countries complied with their 2018 or 2019 ceilings for sulphur dioxide. In both years, sulphur dioxide emissions from the coal power plants included in the NERPs were, in total, around six times as high as the sum of the countries' emission ceilings.[100] Dust emissions were also, in total, almost 1.6 times as high as the sum of the allowed ceilings.

In March 2021, the Energy Community Secretariat therefore opened dispute settlement cases against Bosnia and Herzegovina, Kosovo, North Macedonia and Serbia for failure to adhere to their NERP ceilings in 2018 and 2019.[101]

Montenegro also became non-compliant with the Large Combustion Plants Directive in 2020, by using up the 20,000 hours allowed under the opt-out regime and continuing to operate the Pljevlja power plant. For this reason, the Energy Community Secretariat opened a dispute settlement case against Montenegro in April 2021.[102]

The year 2020 was expected to result in a drop in emissions, due to the reduction of economic activity as a result of the COVID-19 pandemic. But in fact, sulphur dioxide emissions from the coal plants included in the NERPs increased compared to 2018 and 2019. They were 6.4 times as high as the sum of the countries' ceilings.

Moreover, in 2020 the total SO_2 emissions from coal-fired power plants in the Western Balkans were 2.5 times as high as those from all coal plants in the EU.

In 2020, total dust emissions were still 1.6 times as high as the countries' combined ceilings, and in absolute terms had even increased somewhat.

Only total nitrogen oxide emissions were still below the combined ceilings for 2020 on the regional level. However, Bosnia and Herzegovina and Kosovo breached their national ceilings, and regionally, the emissions have slightly increased. Since the annual ceilings are tightening every year, there is no room for complacency here, either. By 2020, emissions had reached 0.9 times the combined ceilings for NO_x, so unless further action is taken quickly, more breaches are also likely to occur for this pollutant in the coming years.

In 2020, Serbia's NERP plants were the highest SO_2 emitters, with 333,602 tonnes, followed by Bosnia and Herzegovina with 220,411 tonnes. Serbia's coal plants emitted more SO_2 than all plants in the EU put together in 2020.

In absolute terms, Ugljevik in Bosnia and Herzegovina was once again the highest-emitting unit for SO_2 in the region in 2020, with 107,402 tonnes.

100 *In some cases, these ceilings also include gas or oil plants, so the exceedances by the coal plants are particularly high.*

101 *Energy Community Secretariat, Secretariat initiates dispute settlement procedures against four Contracting Parties in relation to NERPs, 16 March 2021.*

102 *Energy Community Secretariat, Secretariat launches dispute settlement procedure against Montenegro for breaching Large Combustion Plants Directive as TPP Pljevlja exhausts 'opt-out', 20 April 2021.*

Yet all four countries together had a limit of 103,682 tonnes – meaning that one plant alone breached this ceiling for the entire region.

Kakanj 7 in Bosnia and Herzegovina was the worst offender in terms of breaching its individual ceiling in 2020, emitting almost 15 times as much as allowed. Ugljevik and Serbia's Kostolac B1+2 both emitted almost 12 times as much as allowed, despite having desulphurisation equipment fitted.

Out of a total of 19,000 deaths caused by Western Balkan coal plants from 2018 to 2020, the total number of deaths during this period caused by exceedances of NERP ceilings was nearly 12,000. More than half of these occurred in EU countries with 7,000 deaths affecting EU citizens, 3,700 deaths in the Western Balkans, and 960 in other regions affected by Western Balkan pollution.

In 2020, the country suffering the most from these emission exceedances was Italy, with 605 deaths, followed by Serbia with 600 deaths.

The modelled results show that overall, between EUR 6.0 and EUR 12.1 billion is estimated to have been incurred in health costs in 2020 due to the emission exceedances alone from the Western Balkan coal plants.

Close to three quarters of these (73 per cent) relate to people and countries in the EU (EUR 4.4 to 8.9 billion), 21 per cent to Western Balkan countries and the remaining 6 per cent to other countries.[103] The costs are borne both at the individual and national levels; through personal costs for medical treatment, increased national healthcare budgets and reduced productivity (which exacerbates the economic impact).

The EU is a net importer of electricity,[104] including from the Western Balkans. Thus, it bears not only some of the health costs of coal power generation in the region, but also some of the responsibility. From 2018 to 2020, the Western Balkans exported 25 TWh of electricity into the EU, amounting to 8 per cent of the total coal-fired power generation in Western Balkans. Hence, the EU plays a significant role in sustaining coal-based electricity in the region.

The EU's imports of electricity from the Western Balkans make up only a miniscule 0.3 per cent of the EU's total electricity consumption, but the SO_2 emissions associated with these imports equal 50 per cent of the entire emissions from all power plants in the EU in 2020. This is because power generation in the Western Balkans is around 300 times more SO_2-intensive than in the EU. For this reason, and since the countries are aspiring EU members, action by the EU to tackle air pollution inevitably needs to include the Western Balkans as well.

Recommendations

More than three years after the Large Combustion Plants Directive entered into force in the Energy Community, the need for governments and utilities to cut pollution is greater than ever. Due to the lack of timely action, the measures taken now need to be drastic. People's health cannot wait for years until plants close or pollution control equipment is installed.

Plants operating under the opt-out regime must limit their operation to 20,000 hours between 2018 and the end of 2023, after which they need to close.[105] But governments and utilities also need to consider closing other plants earlier than planned and reducing their operating hours in the meantime, particularly the oldest plants and those which require the highest investments to become LCPD-compliant. This of course requires consideration of security of supply, but demand can also be reduced by other means such as reducing distribution losses, other energy efficiency measures, and use of efficient heat pumps for heating instead of electrical resistance heaters. Closing plants early will also mean that plans for a just transition of the coal mining regions need to be speeded up, and need to be planned in a participatory manner.[106]

For those plants which cannot be closed within the next few years, the most urgent matter is to ensure that the Ugljevik and Kostolac B desulphurisation units function properly. Investments in desulphurisation and dust control equipment also need to be speeded up at a limited number of other plants and in the meantime, operating hours need to be reduced to decrease the pollution burden.

103 *Algeria, Belarus, Liechtenstein, Moldova, Russia, San Marino, Switzerland, Tunisia, Turkey, Ukraine, Vatican City.*

104 *European Commission, Electricity and Heat Statistics, 2020.*

105 *The other option is to undergo major reconstruction to comply with the emission limit values for new plants under the Energy Community Treaty, but we are sceptical that this would be economically feasible in the majority of cases.*

106 *For more information, see also CEE Bankwatch Network, Eight steps for a just transition in the Western Balkans.*

In order to achieve efficiency of investments and maximise their benefits for human health, any new pollution control equipment should ensure that plants reach the latest EU standards,[107] rather than just the obligatory minimum ones. It is also crucial to ensure that the equipment is of sufficient quality and that it is used in reality. Publishing real-time emissions data from continuous monitoring would help to build public trust that this is really the case.

The Energy Community needs to have stronger enforcement tools at its disposal, for the benefit of human health and the environment. The Treaty's dispute settlement mechanism needs to be strengthened to include dissuasive penalties for breaches, and mechanisms for CO_2 and potentially also pollution pricing need to be introduced in the Energy Community countries to level the playing field in the European electricity market.

To all the Western Balkan governments

- Reduce operating hours for non-compliant plants in order to comply with emissions ceilings until pollution control equipment is functioning or the plants are closed.
- Use the National Energy and Climate Plan development process to make clear and transparent plans for the phased closure of all coal plants and overall coal and fossil fuel phase-out dates. The plans must take into account the likely impacts of carbon pricing and/or a carbon border adjustment mechanism in the coming years.
- Ramp up investments in solar, wind and the reduction of grid losses, as well as the use of efficient heat pumps for households instead of electrical resistance heaters, in order to minimise the need to keep old coal plants online.
- Increase the amount of attention given to participatory planning for a just transition at those coal plants and mines which will close first.
- For those plants which will remain in operation for several more years, in order to achieve efficiency of investments and maximise their benefits for human health, new pollution control equipment should ensure that plants reach LCP BREF 2017 standards, rather than just the obligatory LCPD and IED Annex V values.

To the Bosnia and Herzegovina authorities

- Immediately reduce the operating hours of all plants that are breaching their NERP ceilings.
- Resolve the issues with the Ugljevik desulphurisation equipment. Once online, undertake real-time monitoring to ensure that the desulphurisation is being used at all times.
- Speed up the desulphurisation investments at Kakanj 7 and Tuzla 6 for which investment decisions have already been taken and publish tenders for denitrification at both units by the end of 2021.
- Use the process of defining the Integrated Energy and Climate Plan for Bosnia and Herzegovina to set the earliest possible closing dates for Gacko, Kakanj 6 and Tuzla 5, as it seems unlikely that substantial investments in pollution control will prove feasible for these units.
- When carrying out environmental impact assessments for emissions reduction measures, ensure that the EIA studies contain detailed information on the technology to be used, what is to be done with by-products such as gypsum, and the expected results in terms of emissions reductions.

[107] *Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants (notified under document C(2017) 5225)*

To the Kosovo authorities

- Urgently reduce dust emissions from Kosova B, initially by reducing operating hours to meet the plant's ceilings until the modernisation project is complete.
- Immediately reduce the operating hours of all units to bring them in line with their NERP ceilings and start closing Kosova A, unit by unit, as it seems unlikely that further investments in pollution control would be economically justifiable.
- Use the process of defining the National Energy and Climate Plan for Kosovo to set the earliest possible closing date for Kosova B. Based on this, assess the feasibility of further pollution control investments.
- Ensure the speedy completion of the project to improve continuous monitoring at Kosova B.

To the Montenegro authorities

- Take the Pljevlja plant offline pending a decision on its retrofit or closure.
- Annul the tender previously carried out for a partial modernisation of the plant due to its lack of integrity and lack of public information about the effectiveness of the technologies and measures to be applied.
- Publish a clear feasibility study and cost-benefit analysis on the potential modernisation of the plant compared to early closure of the coal plant and replacement by energy savings and the planned solar and wind plants in the coming years.

To the North Macedonia authorities

- Formalise the closure of REK Oslomej.
- By the end of 2021, decide on the future of REK Bitola and its rehabilitation or closure, and issue its IPPC permit. Keep operating hours as low as possible to comply with ceilings until dust and SO_2 control equipment is fitted or the plant is closed.

To the Serbia authorities

- Urgently clarify to the public the reasons why the Kostolac B de-SO_X was not working for more than three years and publish the results of the test operations on a regular basis.
- Put construction of Kostolac unit B3 on hold at least until it is clarified whether there are issues with CMEC's pollution control technology.[108]
- Ensure the timely and effective completion of the ongoing projects to fit desulphurisation equipment at the Nikola Tesla A3-6 and B1-2 plants.
- Considering that investments in desulphurisation are now underway at Serbia's main coal plants, the focus for the remainder of the plants should now be on planning for closure and just transition for the workers depending on the plants.

[108] *We recommend dropping the investment completely, for climate, health and economic reasons; however, the recommendation listed is derived from the contents of this report.*

To the Energy Community

- Continue to assist the Contracting Parties in the development of their National Energy and Climate Plans, ramping up investments in sustainable forms of renewable energy and on carbon pricing, the phasing out of coal subsidies and preparing for a just transition.

To the European Commission and EU Member States

- Support the strengthening of the Energy Community Treaty to ensure dissuasive penalties in cases of non-compliance.
- Ensure that the planned carbon border adjustment mechanism includes the electricity sector and helps to prevent power from non-compliant plants being traded with the EU. This may also involve including a pollution border tax element. Revenues should be used to help willing countries to advance their energy transition.
- Withhold financing for projects related to electricity interconnectors and other projects that might aid non-compliant plants in selling their electricity to the EU.
- Ensure that IPA III financing and other international finance supports energy transition rather than the lifetime extension of coal power plants, in order to ensure the 'polluter pays' principle is applied. Likewise, international finance must not support any other fossil fuels, in order to avoid creating further fossil-fuel lock-in.

Kosovo B power plant, Kosovo
Photo credit: Balkan Green Foundation

Annex 1

Materials and methods

The emissions of Western Balkans coal power plants were collected from the EIONET Central Data Repository, report version 30 March 2021, data that will only within the next few months be verified by the European Environment Agency. Where available, we have used verified emissions figures from the European Environment Agency for 2018 and 2019, which may lead to some figures being somewhat different than those quoted in the previous Comply or Close reports. The National Emission Reduction Plans used are official documents published by each of the countries. The overall country level ceilings used as reference include, in some cases (e.g. Serbia), emissions ceilings from other facilities that are not coal power plants (e.g. refineries), which explains why in those cases the national ceilings are higher than the sum of individual coal power plants' ceilings.

Exports

Hourly export and generation data were collected from ENTSO-E, the European Network of Transmission System Operators. The hourly data for 2018, 2019 and 2020 included the Western Balkan countries' exported electricity separately for each importing EU country. The hourly export and generation data were aggregated monthly and yearly for the years and countries included in this study. ENTSO-E includes all the hourly and generation data for the countries studied in this report except for Kosovo. Electricity export data and the generation mixes for Kosovo were collected from the Republic of Kosovo's Energy Regulatory Office's annual reports for 2018 and 2019.

Having calculated the total production and total value of coal-fired production for each country and each year, we then assessed the share of coal. The share of coal exports was calculated similarly.

Until recently, ENTSO-E reported only combined data for Serbia and Kosovo. Since there are no direct transmission lines from Kosovo to the EU but Kosovo is a net exporter of electricity to Serbia, we assumed that exports from Serbia into the EU included electricity produced in Kosovo in the same proportion as Kosovo's share in power generation within the combined data for Serbia and Kosovo.

Atmospheric modelling

The atmospheric model we used to assess the air quality impacts of the emissions was developed under the European Monitoring Programme (EMEP) of the Convention on Transboundary Pollution (CLRTAP), of which the Western Balkan countries (with the exception of Kosovo) are parties, giving the model an official status. The model simulates the dispersion, chemical transformation and deposition of pollutants in the atmosphere, using a full year of meteorological data. Model predictions are validated against air quality measurements by EMEP in its annual reports.

For the first time, we developed a framework for the Western Balkans that quantifies the population exposure to air pollution and resulting health impacts from coal power plant emissions per tonne of pollutant, using detailed atmospheric simulations. This way, we are able to estimate the health impacts attributable to e.g. exceedances of emissions ceilings or emissions associated with electricity exports, year by year, without requiring a new model simulation for each change in emissions.

We used the model to carry out a total of 17 simulations, starting with a baseline simulation including all air pollutant emissions from all sectors. We then removed the emissions from the studied coal power plants from the modelling inputs, simulating a situation where all coal power plant emissions in Western Balkans are eliminated ('full zero-out') – the difference in air pollutant concentrations between the results for these two simulations is the estimated contribution of the coal power plants to air pollution.

To develop estimates of impacts per tonne, we then modelled each pollutant (sulfur dioxide, nitrogen oxides, particulate matter) separately from each Western Balkan country that has coal-fired power plants, setting the emissions of one pollutant from one country to zero at a time ('country- and pollutant-specific zero-outs').

We compared the health impacts calculated using the factors from the country- and pollutant-specific zero-out simulations to the results from the full zero-out to ascertain that there aren't non-linearities in the model that would substantially affect the results; the results were within 5 per cent of each other, a close alignment given the overall uncertainty in the estimates.

The baseline emission inventory for the model, including emissions of all sectors in all countries at a resolution of 0.1x0.1 degrees, was also developed under EMEP. We updated the inventory to the latest emissions data for coal-fired power plants, replacing the electricity sector emissions values in the grid cells containing coal-fired power plants with the emissions data for each power plant.

Health impact assessment

The reported health impacts under each country profile are totals of the respective country's power plants' emissions exceedances over the entire modelled region. The modelled region includes the Western Balkans, EU27 and other regions in central and eastern Europe as well as Northern Africa.

The health impact results were modelled from the pollutant concentrations of the plants included in this study. The pollutant concentrations were evaluated by assessing the resulting population exposure, based on high-resolution gridded population data[109] for 2015, aggregated to the model grid.

To evaluate the health impacts, the WHO recommendations for concentration-response functions and health impact assessment in Europe from the HRAPIE project, were applied. WHO HRAPIE groups A and B with different levels of uncertainty were used, as per the HRAPIE recommendations, to estimate the total effect as one option for impact analyses. All grid cells had the affected fractions of population applied evenly.

WHO databases and technical guidance on the implementation of HRAPIE recommendations were accessed for baseline health data.

The health impacts in each grid cell were calculated as follows:

[number of cases] = [population in grid cell] * [affected population fraction] * [baseline incidence] * [change in pollutant concentration] * [concentration-response factor]

with the following understandings:

- *Baseline incidence: the incidence or prevalence of the studied impact in the population – excluding the impact of the modelled coal emissions; e.g. respiratory hospital admissions per 100,000 people.*
- *Affected population fraction: the percentage of the total population that the impact estimate is applied to; e.g. population aged 1 month to 12 months for infant mortality.*
- *Change in pollutant concentration: the change in predicted concentrations between the baseline and the simulations.*
- *Concentration-response factor: the percentage increase in cases per increase in pollutant concentration derived from scientific studies, e.g. if PM2.5 concentrations increase by 10 µg/m^3 over a long period of time, an 8 per cent increase in bronchitis cases in children may occur.*

[109] *Center for International Earth Science Information Network (CIESIN) - Columbia University, Gridded Population of the World, Version 4 (GPWv4): Population Density Adjusted to Match 2015 Revision UN WPP Country Totals, Revision 11, Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC), 2018.*

Pollutant	Effect	Affected population fraction	Incidence rate	Response function	Concentration increase ($10\mu g/m^3$)	HRAPIE group
PM_{10}	Incidence of chronic bronchitis, population aged over 27 years	67.6%	0.39%	11.70%	10	11.70%
PM_{10}	Bronchitis in children, ages 6-12 years	7%	18.6%	8%	10	8%
PM_{10}	Incidence of asthma symptoms in asthmatic children, ages 5-19 years	0.6%	62%	2.8%	10	2.8%
$PM_{2.5}$	Respiratory hospital admissions, all ages	100%	1.165%	1.9%	10	1.9%
$PM_{2.5}$	Cardiac hospital admissions, all ages	100%	2.256%	0.91%	10	0.91%
$PM_{2.5}$	Restricted activity days (RADs)	100%	19%	4.7%	10	4.7%
$PM_{2.5}$	Work days lost, working age population	42.5%	9.4%	4.6%	10	4.6%
Ozone (SOMO35)	Minor restricted activity days, all ages	100%	7.8%	1.54%	10	1.54%
Ozone (SOMO35)	Respiratory hospital admissions, ages over 64 year	16.4%	2.2%	0.44%	10	0.44%
Ozone (SOMO35)	Cardiovascular hospital admissions, ages over 64 years	16.4%	5%	0.89%	10	0.89%
NO_2	Bronchitis in children, ages 5-14 years	0.5%	1.52%	2.1%	1	2.1%
NO_2	Respiratory hospital admissions, all ages	100%	1.165%	1.8%	10	1.8%

Table 12: *Concentration response functions, population, and morbidity data for non-fatal health impacts*

Impact	Subgroup	Pollutant	Central	95% Confidence Interval: Low	95% Confidence Interval: High
All cause natural mortality from chronic exposure	Over 30 years	$PM_{2.5}$	6.20%	4%	8.30%
All cause natural mortality from acute exposure	All ages	O_3	0.29%	0.14%	0.43%
All cause natural mortality from chronic exposure	Over 30 years	NO_2	5.5%	3.1%	8.0%
Infant mortality (HRAPIE group B*)	1 month to 12 months	$PM_{2.5}$	4.0%	2.0%	7.0%

Table 13: *Concentration response functions for mortality*

The mortality estimates include the effect of direct NO_2 exposure, in line with WHO recommendations. The central and low estimates of mortality in this report only include two-thirds of the NO_2 mortality effect based on a single pollutant risk model. This is because of possible overlap with $PM_{2.5}$ health impacts identified by the WHO (HRAPIE project report).

Economic costs

The costs in this study refer to direct costs, including health care costs and economic losses, as well as a measure of people's willingness to pay, meaning the price individuals would pay to avoid a small additional risk of death or a disease. This approach is used by both the European Commissions as well as the World Health Organization.

The cost estimations are based on updated prices from the 2014 EU Clean Air Policy Package's impact assessments, which used 2005 prices. The prices were updated according to the geographical location of the health impacts:

- EU: the 2005 prices were adjusted to 2020 using the GDP-weighted average GDP deflator for EU countries
- Western Balkans: 2005 prices were adjusted by the ratio of the 2020 population-weighted Western Balkan GDP per capita (power purchasing parity – PPP) to the 2005 EU GDP per capita (PPP). An elasticity of 0.8 was applied to account for the variation in willingness to pay as incomes change.
- Other countries: 2005 prices were adjusted by the ratio of the 2020 national GDP per capita (PPP) value to the 2005 EU GPD per capita (PPP). An elasticity of 0.8 was applied to account for the variation in willingness to pay as incomes change.

Outcome	EU27 Monetary value, EUR 2020 prices	Western Balkans Monetary value, PPP adjusted EUR 2020 prices
Asthma symptoms in asthmatic children	31	20
Bronchitis symptoms in asthmatic children	375	274
Bronchitis in children	421	274
Cardiovascular hospital admissions	1,566	1,029
Adult deaths	2,559,355	1,396,651
Hospital admissions	1,528	1,029
Incidence of chronic bronchitis in adults	63,707	34,209
Minor RADs	48	27
Infant deaths	3,643,042	2,159,788
Restricted activity days	50	27
Work days lost	120	33

Table 14: *Monetary values applied to health outcomes for the EU and the Western Balkans*

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