The state of the European Union – Ukraine Association Agreement implementation on the air quality

Ye B Shapovalov\(^1\), I L Yakymenko\(^2\), O M Salavor\(^2\), K Šebková\(^3\)

\(^1\) National Center “Junior Academy of Sciences of Ukraine”, Kyiv, Ukraine
\(^2\) National University of Food Technology, Kyiv, Ukraine
\(^3\) Research Centre for Toxic Compounds in the Environment, Masaryk University, Brno, Czech Republic

E-mail: sjb@man.gov.ua, iyakymen@gmail.com, oksalavor@gmail.com, katerina.sebkova@recetox.muni.cz

Abstract. The comparative analysis of laws and regulations on air quality, air protection, and its monitoring in the EU and Ukraine has been carried out to analyse the state of the European Union – Ukraine Association Agreement. The main features of the strategic documents “Europe 2020” and “Ukraine 2020” air pollution control are discussed. The analysis of air quality monitoring regulations, air quality control methods, and peculiarities of citizens’ alerts in the EU and Ukrainian legislation is provided. It is proven that the methods approach to limiting pollutant values differs in Ukraine and the EU. EU uses limit value’, ‘target value’, ‘alert threshold’, ‘information threshold’ and ‘critical level’ and Ukraine uses limiting values. The limit values/permissible concentrations of carbon dioxide, sulfur (IV) oxide (average daily value), and lead are stricter in Ukraine. However, the permissible concentrations of PM10, sulfur (IV) oxide (short-term value), Arsenic, Cadmium, and Nickel are much lighter in Ukraine than in the EU. The dioxin content in ambient air is not regulated in Ukrainian legislation. Also, citizens’ monitoring systems and data provision differ and should be harmonised for the EU’s standards. The current state of roadmap implementation is firstly presented. It is demonstrated the necessity to harmonise the Ukrainian law and regulations on air quality control and air protection with the EU law.

1. Introduction
Implementing science-based environmental approaches and standards in legislation and everyday practice is an significant part of sustainable development. European Union standards are one of the most progressive in the field. They are usually preventive, consider global consequences, meet the requirements of sustainable development and are science-based. Implementation of the European Union laws and regulations into Ukrainian environmental laws is an part of the effective integration of Ukraine into the European community according to the EU-Ukraine Association Agreement [1, 2]. Therefore, it is valuable to provide a comparative analysis of the Ukrainian legislation to correspond to European laws and regulations. One of the parts of the EU’s environmental policy is ambient air quality control and air protection.

The main environmental policy goals are determined by strategic documents for the EU and Ukraine. Also, strategic documents are an essential part of the sustainable development of
society. Moreover, other legislative acts aim to implement strategic documents’ goals. So, this paper analysing strategy and EU's environment documents and their implementation state in Ukrainian legislation.

2. Literature review
A commitments of Ukraine in the field Environment (including air quality) is declared in Annex XXX of the Association Agreement between the European Union and its Member States and Ukraine incorporating Chapter 6: Environment [1, 2]. Furthermore, the general state of the fulfilment of the commitment is described annually in Reports prepared by the European Commission [3], the Ukrainian government [4] and by the Ukrainian Center of European policy [5]. However, it does not provide a detailed analysis of the scientific aspect of European integration in specialized fields, inducing practical aspects and compressing analyzing the existing state of the standards and those declared in European Law.

The science-sound analysis is provided in very few papers. Dmitrieva et al. provided an analysis of the implementation of the monitoring quality in Ukraine and the state of its corresponding to the requirements declared in Directive 2008/50/EC [6]. It was proven that in Ukraine, no standards declare the amount and location of the monitoring posts. In addition, the list of the action that needs to be done to harmonize the current state of the air quality monitoring system to European standards is described. Bashtanik et al. has declared the necessity of the Directive 2008/50/EC implementation in Ukrainian Law [7, 8]. In addition, Directive 2008/50/EC has been used to evaluate the dust air-pollution dynamics in certain Ukrainian cities [9].

Despite that, scientists in countries with high rates of European integration, such as [10,11], Serbia [12, 13] and Moldova [14,15] and inside of the EU [16,17] provide scientific analysis of both, state of implementation (harmonization) and detailed analysis of legislation on air quality. However, there is no science-sound analysis of the state of implementation and analyzing the current state of legislation in Ukraine and the state of harmonization to the EU standards. Also, it seems relevant to analyze limiting valises in the EU and Ukraine, which will be helpful for further researchers to evaluate measured data on air quality using both, actual Ukrainian standards and European ones. Plans related to the improvement of the air quality is declared in both, Europe 2020 and Ukraine 2020, but there is no analysis of them related to air quality. Therefore, this research aims to analyse EU’s legislation and the current state of its implementation in Ukrainian legislation according to Association Agreement, including, state of air quality monitoring system, types of limiting values, comparing of limiting values of pollutants, alerting system and publicity access to the data.

3. Methods of analysis
Both, Ukrainian laws and regulatory documents were analysed. As the main document, EU-Ukraine Association Agreement was used to analyse. Deduction, induction, and synthesis were used to analyze the documents. Reports of both the EU and Ukraine on the Agreement implementation were considered.

4. Results and discussion
4.1. Comparison of the strategic documents Europe 2020 and Ukraine 2020 strategies on the air quality goals
The EU’s member states were guided by the Sustainable Development Strategy Europe 2020, adopted in 2010 [18], based on the principles pledged in the previous strategy, “A Secure Europe In a Better World” [19]. Among others, it proclaims the 20/20/20 climate/energy target. According to this target, greenhouse gas emissions in the EU should be reduced by at least 20% compared to the 1990 level, or even by 30% if it is possible; the renewable sources should cover at
Table 1. Content of produced gas.

| Goal                                      | Europe 2020                        | Ukraine 2020                        |
|-------------------------------------------|------------------------------------|------------------------------------|
| Greenhouse gas emissions                  | Decrease by 20%                     | Not regulated                      |
|                                           | (compared to 1990)                  |                                    |
| Getting energy from renewable sources     | Provide 20% of consumed energy from the renewables | Implementation of alternative energy sources (without quantitative indicators) |
| Increase the energy efficiency of production | Increase by 20%                   | By 20 % till 2020                  |
|                                           | compared to 2010                    |                                    |

least 20% of energy consumption; and energy efficiency should be increased by 20% compared to 2010. The strategy envisages a reduction of dependence of economic growth on resource supply (resource efficiency), proclaims a low-carbon economy approach, including increasing the use of renewables, transport sector modernization, and energy efficiency steady improvement [18].

The strategy Europe 2020 in the field of ambient focuses to affect [18]:

(i) Particulate matter (PM2.5) and ozone effects on public health and the environment;
(ii) Acidification (control of emissions of sulphur (IV) and ammonium oxide, nitrogen) and eutrophication (nitrogen precipitated above critical loads);
(iii) Impact of ozone on vegetation;

The strategy involves the implementation of:

(i) Euro-5 standards for cars and vans;
(ii) Euro-6 standards for heavy vehicles;
(iii) Revision of national emission limits;
(iv) Regulation of low-power combustion plants;
(v) Reduction of ammonia emissions in agriculture;
(vi) Review of legal acts in the field of air quality [18].

In Ukraine, the strategy of sustainable development in Ukraine 2020 was adopted in 2015 [20]. The document partially describes the strategic aspects of ambient air regulation, particularly greenhouse gas emissions. Comparisons of the Ukraine 2020 and Europe 2020 for climate/energy targets are presented in table 1.

As shown in table 1, the Europe 2020 strategy provides more clear climate/energy strategic goals and clearly defines quantitative indicators to evaluate the progress in the strategy implementation for greenhouse gas emissions and renewable energy supply. Instead, Ukraine 2020 strategy only identifies energy efficiency improvements, while other aspects of the strategy do not have clear criteria for progress assessment. But as for the goals of Ukraine, they would not be enough to solve the problem taking into account that the Ukrainian mean energy intensity of GDP is higher than the world’s mean by 2.6 times [18–20].

According to the EU-Ukraine Association Agreement, Ukraine has a strategic plan for EU law implementation. Therefore, it is necessary to analyse the integration state, and the article aims it.
4.2. Basic legislation of the EU and Ukraine on air quality

The EU regulatory framework for air quality monitoring includes the following regulatory documents:

(i) Directive 2008/50/EC on ambient air quality and cleaner air for Europe [21];
(ii) Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air [22];
(iii) Council Directive 87/217/EEC on the prevention and reduction of environmental pollution by asbestos [23];
(iv) Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants [24].

The legislation of Ukraine on ambient air includes the following documents:

(i) Law of Ukraine on the “Air Protection” [25];
(ii) Order of Ministry of Health Protection of Ukraine “On Approval of the Hygienic Standard List of Industrial Allergens” [26];
(iii) Order of Cabinet of Ministers of Ukraine “On approval of the procedure for the development and approval of standards for permissible emission of pollutants from stationary sources [27];
(iv) “Maximum permissible concentrations of chemical and biological substances in the ambient air of inhabited places” approved by Chief Doctor of Ukraine [28];
(v) Order of Cabinet of Ministers of Ukraine “On approval of the list of the most common and dangerous pollutants whose emissions into the air are subject to regulation” [29].

The framework air quality law of the EU is Directive 2008/50/EC [21], which regulates the main principles of air protection and control of air quality in the member states. Also, there are EU directives that regulate specific indicators, such as Directive 2004/107/EC on the regulation of concentrations of arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air [22], Directive 87/217/EEC on reducing exposure to asbestos into the atmosphere [23] and Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants [24].

Directive 2004/107/EC [22] establishes the targets value for arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air, as well as upper and lower assessment thresholds, location criteria, the minimum number of sampling points for measuring atmospheric pollutant concentrations and sampling methods. Furthermore, the Directive obliged the EU’s member states to undertake all necessary measures to ensure that from December 31, 2012 concentrations of Arsenic, Cadmium, Nickel and benzene(a)pyrene and polycyclic aromatic hydrocarbons should be used as an indicator for the carcinogenic risk in the ambient air, according to the assessment and their values should not exceed the limits set by the Directive [22].

Nowadays, limit values for pollutants in the atmosphere in Ukraine are regulated by a document approved by the chief physician of Ukraine, “Maximum permissible concentrations of chemical and biological substances in ambient air of populated areas” [28]. Also, it should be noted that severe standards for air quality may be established for resorts, recreational, and some other special areas (Article 6 of the Law of Ukraine on the “Air Protection” Ukrainian Law on Air protection).

It should be underlined that the approaches to air pollutants’ control are different in Ukraine and the EU. European legislation provides such indexes as “limit value”, “target value”, “alert value”, “information value”, and “critical level for vegetation and ecosystems” (critical level) [21]. Alert value and information value are intended to inform the population about potentially risky pollutants concentrations. In cases where it is impossible to implement a scientifically substantiated value of the content of pollutants in the air, “mean value” is used. According to Directive 2008/50/EC, target value means the level established to avoid, prevent or reduce
harmful effects on human health and/or the environment as a whole, which should be achieved whenever possible within the set period. Directive 2008/50/EC on ambient air quality and cleaner air for Europe also defines types of limitation levels of pollutants in the air as follows [21]:

- ‘limit value’ shall mean a level fixed on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained within a given period and not to be exceeded once attained;
- ‘target value’ shall mean a level fixed with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained where possible over a given period;
- ‘alert threshold’ shall mean a level beyond which there is a risk to human health from brief exposure for the population as a whole and at which immediate steps are to be taken by the Member States;
- ‘information threshold’ shall mean a level beyond which there is a risk to human health from brief exposure for particularly sensitive sections of the population and for which immediate and appropriate information is necessary;
- ‘critical level’ shall mean a level fixed on the basis of scientific knowledge, above which direct adverse effects may occur on some receptors, such as trees, other plants or natural ecosystems but not on humans.

Thus, the European Union legislation provides control over ambient air, considering both public health and the state of ecosystems, as well as informing the population. The Ukrainian regulatory framework foresees the use of maximum permissible concentrations that considers only human health, not the environment and it does not imply informing the population.

According to the Order of the Cabinet of Ministers of Ukraine, “On approval of the list of the most common and dangerous pollutants whose emissions into the air are subject to regulation” 2001, No. 1598 [27], the most common pollutants are nitrogen (II) oxide, sulphur (IV) oxide and its other compounds, carbon (II) oxide, ozone. In addition, hazardous pollutants include metals and their compounds, organic amines, volatile organic compounds, persistent organic compounds, Chlorine, Bromine, Fluorine, and their compounds, etc. [27].

In general, the approaches to control the level of air pollutants in Ukraine and the EU are significantly different and need to be harmonized. The limit values/permisible concentrations of carbon dioxide, sulfur (IV) oxide (average daily value) and lead are stricter in Ukraine. However, the permisible concentrations of PM10, sulfur (IV) oxide (short-term value), Arsenic, Cadmium, and Nickel are much lighter in Ukraine than in the EU. In addition, the dioxin content of ambient air is not regulated in Ukrainian legislation. Also, in Ukraine, the content of particulate matter (PM2.5) in the atmosphere is still insufficiently regulated, and there is no regulation of all types of particulate matter as defined by Directive 2008/50/EC. Therefore, it’s necessary to align these indicators for Ukraine with European Union legislation. Benzopyrene and nitrogen (IV) oxide limit values are identical in Ukraine and the EU (table 2) [21].

Directive 2008/50/EC regulates the requirements for the placement of sampling points in the EU and by the RD 02.04.186-89 “Guidelines for the control of atmospheric pollution” in Ukraine. However, the legislation of Ukraine does not have requirements regarding the number of sampling points. Also, in Ukraine, several industrial zones may do not have the required quantity of sampling points compared to European legislation or may do not have them at all [6, 21, 30]. On the other hand, Directive 2008/50/EC regulates detailed rules regarding the location of the sampling point [21].

4.3. Transport’s emissions and air quality legislation

According to the Agreement on Association, Ukraine committed to implementing transport EU’s legislations. It includes Directive 2016/802 relating to a reduction in the sulfur content of
Table 2. Content of produced gas.

| Substance | EU’s indicators, mg/m$^3$ | Ukraine’s indicators, mg/m$^3$ |
|-----------|---------------------------|-------------------------------|
| Greenhouse gas Name | AV, 1h AV, 24h AV, 1 year MV, 8 h MPC, daily MPC, 30 min |
| Arsenic | 0.000006* | 0.003** |
| Cadmium | 0.00005* | 0.0003*** |
| Nickel | 0.000027 | 0.001** |
| Benzopyrene | 0.000001* | 0.000001** |
| NO$_2$ | 0.2** [21] | 0.04** |
| Dioxins | Limited by***** | 0.2** |
| CO$_2$ | 0.05 [21] 10 | 5*** |
| PM$_{10}$ | 0.04** | 0.15***** |
| PM$_{2.5}$ | 0.24** | 0.5***** |
| SO$_2$ | 0.35** | 0.125** |
| Lead | 0.0005** | 0.0003*** |
| Benzene | 0.005** | 0.1** |
| Asbestos | 0.1** | |

* Target Value  ** Limit Value  *** for cadmium compounds  **** total content of suspended particles  ***** Limited by air emissions quantity (not higher than 0.1 ng/Nm$^3$ over a sampling period of a minimum of 6 hours and a maximum of 8 hours)

All Ukrainian indicators are taken from actual regulations declared in [28] Nitrogen (IV) oxide, Sulfur (IV) oxide, PM10. PM2.5, Lead, and Benzene values were taken from Directive 2008/50/EC; Arsenic, Cadmium, Nickel, Benzopyrene contents were taken from Directive 2004/107/EC; Dioxins limitation is presented according to Directive 2010/75; Asbestos content is presented according to Directive 87/217/EEC AV - Annual value MV - Mean value MPC - Maximum permissible concentration.

Certain liquid fuels [31], Directive 94/63/EC on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations [32], Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Council Directive Directive 98/70/EC of European Parliament and of the Council relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC, Directive 93/12/EEC relating to the sulphur content of certain liquid fuels (was replaced by Directive 2009/28/EC), Directive 2000/71/EC to adapt the measuring methods as laid down in Annexes I, II, III and IV to Directive 98/70/EC of the European Parliament and of the Council to technical progress as foreseen in Article 10 of that Directive [33], Directive 2003/17/EC amending Directive 98/70/EC relating to the quality of petrol and diesel fuels [34] and Regulation 1882/2003 adapting to Council Decision 1999/468/EC [35].

However, those Directives are lackey implemented in Ukrainian law. It may be related to transfer and selling of the old EU’s transport to Ukraine which is going on due to the lower...
4.4. Citizens’ information on air quality state
Informing citizens in the EU member states is provided through the online GIS. Information about the state of the environment in real-time can be seen using sites WAQI (https://waqi.info/) or AQICN (http://aqicn.org) (figure 1). In the EU member states, the air quality index (AQI) is applied that is simple to understand and is calculated according to the formula:

\[ I = \frac{(I_{\text{high}} - I_{\text{low}})}{(C_{\text{high}} - C_{\text{low}})(C - C_{\text{low}})} + I_{\text{low}} \]  

Where
\( I \) – air quality index;
\( C \) – the pollutant concentration;
\( C_{\text{low}} \) – the concentration breakpoint that is \( C \);
\( C_{\text{high}} \) – the concentration breakpoint that is \( C \);
\( I_{\text{low}} \) – the index breakpoint corresponding to \( C_{\text{low}} \);
\( I_{\text{high}} \) – the index breakpoint corresponding to \( C_{\text{high}} \).

An example of information on the site http://aqicn.org is presented in figure 1.

Figure 1. An example of information on the site http://aqicn.org.

This indicator gives a relatively clear understanding of the dangers of air quality. The score varies from 0 to 500. Its lower values indicate high air quality, and higher ones are about the danger state of air quality.

Citizen alert in the EU member states occurs when the concentration of sulphur (IV) oxide is 0.5 mg/m³, nitrogen (IV) oxide - 0.4 mg/m³ and ozone - 0.24 mg/m³; and information threshold for ozone is 0.18 mg/m³. The critical level of sulfur (IV) oxide is 0.02 - mg/m³, and for nitrogen oxides - 0.03 mg/m³ [23].

In Ukraine, comparisons with the maximum permissible concentration are used to inform the population. GIS is not commonly used for informing citizens. The reports on air quality are prepared periodically by Hydrometeorological Centre of State Service of Ukraine for Emergency Situations of Cabinet of Ministers once in several months. Consequently, citizens receive air quality information with a delay of several months. An example of information delivery on the sites of the Hydrometeorological Centre is presented in figure 2 (http://gmc.uzhgorod.ua/ZA/092012.htm, Access data: 02.02.2019).
The air monitoring system used in the EU is more visual and allows users to get real-time information, and provides a qualitative and straightforward notification of citizens about the potential dangers, ensuring the safety of citizens with specific health statuses. Therefore, it is advisable to modify the system of informing citizens in Ukraine to meet the features mentioned above of the EU system.

However, Ukraine provides NGOs control by using both online GIS and AQI. To provide this, measures developed by Ecocity project nowadays are using. Those measures are located by the different organizations, including the Junior Academy of Sciences of Ukraine and NGO European Studies’ Platform for Sustainable Development.

5. Discussion

Generally, the European integration state is presented in the reports prepared by the European Commission [3], the Ukrainian government [4] and by the Ukrainian centre of European policy [5]. Main achievements related to environmental field are related to strategic planning, and it includes [4]:

- Providing the automatic system open environment (not implemented yet) [3]
- Cabinet of Ministers endorsed an updated National Environmental Strategy 2030. Implementing the decreasing of air emission plan [3, 4];
- Drafts of Laws “On Monitoring, Reporting and Verifying Greenhouse Gases” and “On ozone-depleting substances and fluorinated greenhouse gases were approved [4];
- The Order of the Ministry of Environmental Protection of 18.02.2018 № 62 provides for the establishment of current and future technological standards for permissible emissions of pollutants into the atmosphere from existing stationary heat and power plants [4];
- Order No. 62 of the Ministry for Environmental Protection of 18.02.2018 “On Amendments to the Order of the Ministry of Environmental Protection of Ukraine dated October 22, 2008 No. 541” provides for the establishment of current and promising technological standards for permissible emissions of pollutants from existing stationary heat and power plants [4].
It was approved Low-carbon strategy of Ukraine to 2050 [4, 36];

It is provided a law on VOC content in paints (Directive 2004/42/EC);

a new Law on Strategic Environmental Assessment (SEA) was adopted [4].

The reports show that Directives 2004/107/EU, 1992/30/EC (repelled by Directive (EU) 2016/802), directive 94/63/EU [32], Directive 98/70/EU were not implemented in full-scale foreseen in EU-Ukraine Association Agreement. Directives 2004/107 and 94/63/EU have not been implemented at all [5]. Directives related to oil quality were implemented particularly:

A. was not successful:

• Changes related to the prohibition of usage of fuels with high sulphur content were implemented by the Technical regulations concerning requirements for motor vehicles gasoline, diesel, ship and boiler fuels (PCM No. 927 of August 1, 2013) It is defined as the body of market supervision - the State Inspection (SCM No. 1069 dated December 28, 2016)

• Particularly it is implemented standards on the fuel quality

• Prohibition of etiolated petrol sales is implemented in the Law of Ukraine “On the Prohibition of the Import and Export on the Territory of Ukraine of Evaporated Petrol and Lead Additives to Gasoline”.

• Requirements for the quality of gasoline and diesel fuel are set in the Technical Regulation on requirements for motor gasoline, diesel, marine and boiler fuels, approved by the KMU Decree No. 927 dated 01.08.2013.

• From January 1, 2018, only gasoline of Euro5 standard is allowed in Ukraine, the quality requirements of which comply with Directive 98/70 / EC.

B. Was successful

• The monitoring system with requirements of Directive 98/70 / EC is not implemented.

Therefore, in practice, directives on fuel quality are not implemented in Ukraine. According to Association Implementation Report on Ukraine. Work is ongoing to prepare legislation to establish an emissions Monitoring, Reporting, and Verification system. In September 2018, a Law drafts on Ozone Depleting Substances and Fluorinated Greenhouse Gases were registered in the Parliament, envisaging the gradual phasing out of these substances. According to the monitoring of the implementation EU-Ukraine Association Agreement, Directive №2004/107/EC, Directive 1999/32/EC, Directive 94/63/EC, Directive 98/70/EC (implementation deadlines from 2014 to 2017) and Directive 2008/50/EC (implementation deadline in 2018) was in work to implement. However, it does not mean that nothing was done about the integration of European legacy in the field of air quality; it means that these legacy acts were not implemented totally, but they were implemented just particularly.

However, those analyses are not representing all aspects of the euro integrational situation of Ukraine related to air quality. Therefore, we provide own analysis. The only aspect of setting up maximum VOC content limit values for paints is implemented in appropriate Ukrainian law [37]. Other points of the Association Agreement on air quality were not implemented in full scale. The general state of integration of the EU’s law is presented in figure 3.

It worth note that state of air quality may be enhanced by using of green technologies, such as anaerobic treatment [38]. However, such technologies may be also unsustainable and cause negative effect on air quality. To ensure sustainability, it is relevant to use modern effective technologies that decrease amount of waste generated by anaerobic treatment such as in works [39] and [40] or modern providing effective technologies to purify both, natural and wastewater such as modern nanotechnologies approaches [41–43]. Also, its sustainability will depend on its optimisation and to define such optimal conditions, using modern informational tools is possible [44].
Figure 3. The general state of integration of the EU’s law implementation in UA’s legislation on air quality.
6. Conclusions

(i) The strategy Europe 2020 is more specific towards improving the environment and ambient air quality than the Strategy Ukraine 2020. Europe 2020 has more clear climate/energy targets and more clearly defined criteria for assessing the implementation of the strategy for emission control, energy efficiency, and renewable energy development.

(ii) Ukraine’s regulatory documents on ambient air protection are partly in line with the EU laws but require some harmonization. The most harmonized part of the regulatory framework for ambient air between Ukraine and the EU is the air quality control methods, and the least harmonized part is regulatory acts related to monitoring the state of the environment (placement of observation posts) and the approach to the air pollutants (maximum permissible concentrations).

(iii) The EU and Ukraine have pretty different approaches to regulating the levels of pollutants in ambient air. Ukrainian legislation foresees the usage of maximum permissible concentrations based on the impact of pollutants on human health. At the same time, the EU legislation also considers the impact of pollutants on the environment. ‘limit value’, ‘target value’, ‘Alert threshold’, ‘Information threshold’ and ‘Critical level’ are used to provide it.

(iv) Almost all regulated values differ between the EU’s and Ukrainian standards. So, it is necessary to harmonize Ukrainian laws with EU legislation. An important uncoordinated indicator of the quality of ambient air in Ukraine is the levels of particulate matter (PM2.5). Unlike the EU, in Ukraine, this index is not regulated at all.

(v) It is advisable to improve the system of notifications of citizens about the air quality in Ukraine using the experience of the EU in this field.

Acknowledgments

Analysis and support of the paper provided in term of the Jean Monnet Support of Associations EUforUA (611278-EPP-1-2019-1-UA-EPPJMO-SUPPA) project.

ORCID iDs

Ye B Shapovalov https://orcid.org/0000-0003-3732-9486
I L Yakymenko https://orcid.org/0000-0002-6308-5449
O M Salavor https://orcid.org/0000-0002-5784-3127
K Sebkova https://orcid.org/0000-0002-5536-7534

References

[1] EC 2014 Official Journal of the European Union L 161 3–2137
[2] 2018 Ukraine and the Association agreement: Stuck in a traffic jam? (Energy Reforms coalition) URL https://dixigroup.org/storage/files/2018-04-18/web_en_ukraine_associationlayout_ukr_dixi_2018_en_1.pdf
[3] EU 2018 Association implementation report on Ukraine Report SWD(2019) 433 final European commision Brussels URL https://data.consilium.europa.eu/doc/document/ST-15105-2019-INIT/en/pdf
[4] 2019 Zvit pro vykonannia uhody pro asotsiatsiiu mizh Ukrainoiu ta Yevropeiskoi ukrainoiu ta Yevropeiskoi (Report on the implementation of the Association Agreement between Ukraine and the European Union) Report Uriadovy ofis koordynatsii yevropeiskoi tvoi yevroatlantichnoi intehtsratsiy Kyiv, Ukraine URL https://www.kmu.gov.ua/storage/app/sites/1/55-GLEEI/ar-aa-implementation-2019-4.pdf
[5] 2018 Ukrainsa ta uhoda pro asotsiatsiiu: monitorynh vykonannia 2014–2018 (Ukraine and the Association Agreement: Monitoring the implementation of 2014-2018) Report Ukrainkyi Tsentr Yevropeiskoi Polityky Kyiv, Ukraine URL https://ucep.org.ua/wp-content/uploads/2020/08/Report_2014-2018_WEB_FINAL.pdf
[6] Dmytryieva O, Varlamov Y, Kvasov V and Palahuta O 2008 Problemy zakhystu dovkillia ta ekolohichna bezpeka 38 99–110 URL http://irbis-nbu.gov.ua/cgi-bin/irbis_nbu_v/cgiirbis_64.exe?121DBN=
LINK&P21DBN=URJN&Z21ID=&S21REF=10&S21STN=1&S21FMT=ASP_meta&S21CNR=20&S21STN=1&S21P03=FILA&e2_S21STR=Ponp_2016_38_12

[7] Bashtannik M, Butler V, Onos L and Savenets M 2020 Naukovi pratsi Ukrainskoho naukovo-doslidnogo hidrometeorolohichnoho instytutu 269 123–137 URL https://www.researchgate.net/publication/343697273_Gsmovni_zasadi_vidilenna_zon_akosti_atmosfernogo_povitru_na_teritorii_Ukraine_ta_ih_klasifikacija_zhidko_z_vimogami_direktiv_2004107ES_ta_200850ES

[8] Bashtannik M, Dvoretska I and Onosm Ludmylaand Savenets M 2016 Opportunity for implementation of 2008/50/EC and 2004/107/EC directives on ambient air quality in Ukraine Ukrainian-Polish Conference The problems of air pollution and purification: control, monitoring, catalytic, and sorption methods of treatment (Dnipro, Ukraine: Serediak T.K.) URL https://www.researchgate.net/publication/309742561_Opportunity_for_implementation_of_200850EC_and_2004107EC_directives_on_ambient_air_quality_in_Ukraine/comments

[9] Nadtochii L, Savenets M, Bashtannik M and Dvoretska I 2019 Ukrainian Geographical Journal(in Ukrainian) 1 43–50 URL https://doi.org/10.15407/ugz2019.01.043

[10] Coskun A, Türker Y and Velioglu N 2011 iForest - Biogeosciences and Forestry 4 181–185 ISSN 1971-7458 URL https://doi.org/10.3832/ifor0585-004

[11] Bűke T and Köne A 016 Sustainability (Switzerland) 8 1–8 URL https://doi.org/10.3390/su8010073

[12] Ljubojev N, Veselinovic J and Dukic-Mijatovic M 2013 Oxidation Communications 36 1217–1231 URL https://doi.org/10.3390/so8010073

[13] Oprenumco A and Prohnit ¸chi V 2009 Climate Change in the Republic of Moldova. Socio-economic impact and policy options for adaptation (Schimb˘ arile Climatice ˆın Republica Moldova. Impactul socio-economic ¸si opt ¸iunile de politici pentru adaptare) (Chi¸ sin˘ au, Republica Moldov: PNUD)

[14] Oprunenco A and Prohnit ¸chi V 2009 Ofitsiinyi visnyk Ukrainy (Official Gazette of Ukraine) 4 29–41 URL https://doi.org/10.5281/zenodo.3871411

[15] Boscaneanu M 2019 Știinţe juridice (Legal Sciences) 10 29–41 URL https://doi.org/10.5281/zenodo.3871411

[16] Misonne D 2019 Review of European, Comparative and International Environmental Law 30 34–45 URL https://doi.org/10.11.1111/reel.12336

[17] Gemmer M and Xiao B 2014 Advances in Climate Change Research 4 50–59 URL https://doi.org/10.3724/SP.J.1248.2013.050

[18] EU 2010 Europe 2020 a strategy for smart, sustainable and inclusive growth Report COM(2010) 2020 final European Commision Brussel, Belgium URL https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52010DC2020

[19] EC 2018 Methods of Using Geoinformation Technologies in Mining Engineers’ Training (Newcastle upon Tyne: Cambridge Scholars Publishing)

[20] 2015 Ofitsiinyi visnyk Ukrainy (Official Gazette of Ukraine) 4 8 URL https://zakon.rada.gov.ua/laws/show/5/2015#Text

[21] EC 2008 Official Journal of the European Union 152 1–44 URL https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:332008L0050

[22] EC 2005 Official Journal of the European Union 23 3–16 URL https://eur-lex.europa.eu/eli/dir/2001/81/oj

[23] EC 1987 Official Journal of the European Communities 85 40–45 URL https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:331987L0217

[24] EC 2001 Official Journal of the European Communities L 309 22–30 URL http://data.europa.eu/eli/dir/2001/81/oj

[25] 1992 Vidomosti Verkhovnoi Rady Ukrainy (Official Gazette of Ukraine) 50 URL https://zakon.rada.gov.ua/laws/show/2707-12

[26] 2007 Ofitsiinyi visnyk Ukrainy (Official Gazette of Ukraine) 23 89 URL https://zakon.rada.gov.ua/laws/show/20285-07#Text

[27] 2006 Ofitsiinyi visnyk Ukrainy (Official Gazette of Ukraine) 31 236 URL https://zakon.rada.gov.ua/laws/show/20912-06#Text

[28] 2020 Ofitsiinyi visnyk Ukrainy (Official Gazette of Ukraine) 15 20 URL https://zakon.rada.gov.ua/laws/show/20156-20#n16

[29] 2001 Ofitsiinyi visnyk Ukrainy (Official Gazette of Ukraine) 49 29 URL https://zakon.rada.gov.ua/laws/show/1598-2001-%D0%BF%0B%F#Text

[30] 1991 Rukovodyashchij dokument rukovodstvo po kontrolyu zagryazneniya atmosfery (Air pollution control guide; in ukrainian) Rukovodyashchij dokument (Guidance document) RD 52.04.186-89 USSR State Committee for Hydrometeorology Moscow, Russia

[31] EC 2016 Official Journal of the European Union L 132 58–78 URL https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L0802&rid=5

[32] EC 1994 Official Journal of the European Union L 365 24–33 URL https://eur-lex.europa.eu/
