Technical Evaluation of Hunutlu Power Plant and Air Pollution in Adana

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The International Agency for Research on Cancer (IARC), the specialised cancer agency of the World Health Organization (WHO), considers that ambient air pollution is carcinogenic to humans (Group-1); causes lung cancer and increases the risk of bladder cancer[1]. Indoor and outdoor air pollution is responsible for 7 million premature deaths around the world on an annual basis. **Ambient air pollution causes approximately 37,000 deaths, 2,300 lower respiratory infections, 17,000 ischemic heart diseases, 5,000 strokes and 4,900 trachea, bronchus and lung cancerper year in Turkey[2].**

The Hunutlu Power Plant is currently being constructed in Yumurtalik district of Adana province, Turkey. This briefing examines air quality data in Adana and also the air pollution monitoring and modelingin the Environmental Impact Assessment (EIA) report of the Hunutlu Power Plant. Additionally, the impactof air pollutant reductions in Adana on the potential prevention of mortalities are examined under three different scenarios.

STATE OF AIR QUALITY IN ADANA

Residents of Adana are exposed to polluted air throughout the year: The PM_{10} concentrations monitoredby the two stationsin Adana city center (Adana Meteoroloji and Adana Valilik) are twice aboveTurkey's and EU's national limits and four times above the World Health Organization guideline values.

Table1: 2019 Annual PM_{10} Average and Annual Limit Values

Turkey and EU's Limits	WHO Guideline Values	Adana Meteoroloji Station	Adana Valilik Station	Adana Çatalan Station	Adana Doğan kent Station
40 µg/m³	20µg/m³	82 µg/m³	52 µg/m³	20 µg/m³	14 µg/m³

According to the "Air Pollution Report", published by the Chamber of Environmental Engineers in 2019, Adana is one of the cities with the largest exceedances of annual PM_{10} national pollution limits. Additionally, the PM_{10} concentrations measured in "Adana Valilik" station exceeded the PM_{10} daily limit of 50µg/m³ on 236 days of 2019. But according to Turkey's regulations, the daily limit of 50µg/m³ must not be exceeded more than 35 days in a year.

$PM_{2.5}$ concentrations and polluted areas are not being measured: Concentrations of $PM_{2.5}$, which is used as the primary indicator to calculate the health impacts of air pollution, are not being measured in any of the four air quality monitoring stations in Adana.

Only two out of four monitoring stations are located at the city center, and air pollution is not being measured at all in areas where large pollutants such as the Organized Industry Zone and the Isken Sugözü Power Plant are located in.

As is the case throughout Turkey, stacks emissions of power plants are not being disclosed for the Adana region, in contrast to publicly available information on large combustion plants on the unit scale in the member states of the European Union (with annual reports)[3]. Regular reporting and disclosure obligations provide an opportunity to estimate cross-border pollution and cumulative impact.

Map 1: Air Quality Measurement Stations and Coal Power Plants in Adana

1 Press release of IARC dated October 2013, https://www.iarc.fr/news-events/iarc-outdoor-air-pollution-a-leading-environmental-cause-of-cancer-death

2 World Health Organization, Global Health Observatory, 2018 (2016 data available), https://apps.who.int/gho/data/node.main.BODAMBIENTAIRDTHS?lang=en

3 European Pollution Release and Transfer Register, https://prtr.eea.europa.eu/#/areaoverview

TWOTHOUSAND DEATHS COULD HAVE BEEN PREVENTED IN ADANA

The Health and Environment Alliance (HEAL) compiled PM_{10} emissions data from air pollution monitoring stations which are coordinated by the Ministry of Environment and Urbanization of Turkey in addition to the population and mortality statistics. We further estimated attributable cases to PM pollution in Adana for 2019 yearunder three different scenarios by using World Health Organization's (WHO) AirQ+ software. The mortality estimate that is calculated by the AirQ+ software predicts potential mortality on the basis of exceeding $PM_{2.5}$ levels over 10 µg/m3 which is WHO's guideline value for annual average. That means, our analysis provides an estimate of prevented mortality due to eliminating $PM_{2.5}$ air pollutant emissions.

According to HEAL calculations, the average mortality due toambient air pollution is estimated as 2,072 among the 9,485 deaths (excluding accidents/external injuries) over the age of 30 in Adana in 2019. In other words, the death of 1 out of 5 people could be prevented in 2019, if air pollution emissions in Adana was kept below the WHO's guideline values.

Methodology:

Step 1: Evaluation of Air Quality Data
In order to determine the health impacts of air pollution, it is necessary to monitor the $PM_{2.5}$ pollutant concentrations. However, there is a need to convert the PM_{10} pollutant concentrations to $PM_{2.5}$ as a starting pointsince the $PM_{2.5}$ pollutant is not being measured at any of the four monitoring stations in Adana. A method for this is to use thenational conversion factor of 0.67 that is set by the World Health Organization for Turkey. However, this conversion factor is based on the 2014 figures where there was no measurement on $PM_{2.5}$ in Turkey. For this reason, the coefficient of 0.75 is used as an average of conversion factors of Gebze and Kesan cities (0.7771 and 0.721 respectively) where both $PM_{2.5}$ and PM_{10} concentrations are measured and the locations show similar characteristics to Adana in terms of ecological characteristicof a bay and existence of heavy industries. According to 0.75 coefficient factor, the average annual $PM_{2.5}$ emission concentration that are measured at two stations at the citycenter of Adana would be 51µg/m^3.On the other hand, the annual $PM_{2.5}$ emission intensity that is measured at four stations across Adana would be 32µg/m^3. Since the population density of the city center and its districts are different, three different scenarios have been conducted within the scope of this analysis.

Table 2: Average Annual PM_{10} and $PM_{2.5}$ Concentrations In 2019

Annual PM concentrations	Adana Meteorol oji Station	Adana Valilik Station	Adana Çatalan Station	Adana Doğanken t Station
Measured PM_{10}	82µg/m^3	52µg/ m^3	20µg/m^3	14µg/m^3
Estimated $PM_{2.5}$	62µg/m^3	40µg/ m^3	15 µg/m^3	11 µg/m^3

Step 2: Determining the Method
The AirQ+ software of the World Health Organization is used for this analysis. All calculations by AirQ+ are based on methodologies and dose-response functions that are developed in epidemiological studies. The dose-response functions used in the software are based on a systematic review and meta-analysis of existing studies. The AirQ+ software assumes[4] non-external mortality risk over 30 years (relative risk coefficient) as 1.062 (95% confidence interval: 1.041-1.084) in case the $PM_{2.5}$ value in outdoor air exceeds 10µg/m^3.
The mortality figures that are estimated by the software provides an estimated mortality number when the $PM_{2.5}$ level exceed 10µg/m^3, in other words ''potential prevented mortality by reducing the PM pollution.''

Step 3: Evaluation of Population and Health Statistics
Within the scope of the study, the following data is used:

- Mortality data of people over 30 years-old (10,031 deaths in total, 9,485 deaths excluding accidents/external injuries) was retrieved from TURKSTAT's "Number of Deaths by Place of Residence" data in 2018. The data is provided on a provincial scale, district level data is not available.
- The data on total population of Adana (2,220,125 in 2018 and 2,237,940 in 2019) was retrieved from the ''Address Based Registration System'' of TURKSTAT at provincial and district levels. In order to ensure consistency with the mortality data, 2018 data was used.
- The population data for the people over the age of 30 (1,346,767 people), was retrieved from the ''Address Based Registration System'' of TURKSTAT for 2018 at provincial and district scales.
- The data on mortality due to external reasons is retrieved from TURKSTAT's 2018 data on "Distribution of selected causes of mortality by residency" (5.44% of total mortality). This data is provided on a provincial scale only as well, district level data is not available.

4Right to CleanAir Platform, "Dark Report: Air Pollution and Its Health Impacts", 2019.

4. Scenarios and Limitations

The AirQ+ software is based on the dose-response function. The dose function is the amount or density of different pollutants, whereas the response function is the size of the population that is impacted by pollution and the disease phenomenon.In our method, the dose function is based on the annual average $PM_{2.5}$concentration and the response function is based on the rate of mortality (incidence) of population over 30 years old.

Four PM concentration measurement stations are located in Adana. As shown in Map1, two of these stations (Adana-Meteoroloji and Adana-Valilik) are located at the highlydense city center, whereas the other two (Çatalan and Doğankent) are located next to the villages and neighborhoods with low population density. However, there is no measurementin the highly polluted İskenderun Bay, where heavy industry is located– as the EIA report of Hunutlu plant monitors and proves the polluted air in the Bay. Therefore, only the two stations at the city center are reasonable to be included in our calculations. However, to ensure full transparency and show the extent of air pollution under different response (population) functions, three scenarios are provided;

- Scenario 1: 2019 $PM_{2.5}$ density (51µg/m^3) in Adana center (Adana-Meteoroloji and Adana-Valilik stations only) and the total population of Adana center and districts (2,220,125 people, population over 30 years is 1,346,767 people).
- Scenario 2: 2019 $PM_{2.5}$ density (51µg/m^3) in Adana center (Adana-Meteoroloji and Adana-Valilik stations only) and population of Adana center(Çukurova, Sarıçam, Seyhan andYüreğir districts) (1,747,567 people, population over 30 years is 1,049,187 people).
- Scenario 3: 2019 $PM_{2.5}$ density (32µg/m^3) of all four stations in Adana center and districts and totalpopulation of Adana center and districts (2,220,125 people, population over 30 years is 1,346,767 people).

Mortalityincidence (30+ years adult) is fixed as 704 per 100,000 for all scenarios based on the national level statistics retrieved from TURKSTAT data.

5. Conclusion

Three different scenarios are developed based on different dose and response functions. Evaluation of the results shows the devastating findings on mortality rates attributed to air pollution under any scenario.

As stated previously, air quality is better in two locations where population density is lower; on the other hand, the air quality is not monitored at all in Iskenderun bay where heavy industry is located. Considering this "balance" factor and the same proportion results under Scenario 1 and Scenario 2, it can be stated that Scenario 1 reflects the most accurate estimations.

To conclude, the average attributable mortality cases due to PM pollution was estimated as 2,072 among the 9,485 deaths (excluding accidents/external injuries) over the age of 30 in Adana in 2019.The mortalityproportionattributed to air pollution is 21.9% of the total mortality. Based on different risk confidence intervals, the calculations show that the number of deaths related to air pollution is estimatedbetween 1,408 and 2,644 in 2019. Based on this result, it is safe to state that "the death of 1 out of 5 people could have been prevented if the air pollution was reduced."

Table3: Estimated Number of Attributable **Cases**to Ambient Particulate Matter Pollution

Scenario	Estimated Number of Attributable Mortality			
	Cases (Central)	Cases (Upper)	Cases (Lower)	Proportion %
Scenario 1	**2,072**	**2,644**	**1,408**	**21.9%**
Scenario 2	1,614	2,060	1,097	**21.9%**
Scenario 3	1,175	1,525	784	**12.4%**

THE HUNUTLU POWER PLANT AND AIR QUALITY

Air quality is already poor at the project site of the Hunutlu Power Plant: The EIA report of Hunutlu Power of July 2013 includes PM_{10} pollutionmonitoringat two locations. Emission values at both locationsexceed the limit values of Turkey's "Industrial Air Pollution Control Directive" which is updated to protect public health and comply with the EU acquis after 2014.

Table 4: PM_{10}Air Pollution Monitoringin Project Site

PM10 Monitoringin the project side (July 2013)		Industrial Air Pollution Control Directive (2013)	Industrial Air Pollution Control Directive (2019 and beyond)
1st location	83 µg/m^3	100 µg/m^3	50µg/m^3
2nd location	50µg/m^3		

These results reveal the alarming state of pollution in the Iskenderun Bay once again even in the absence of continuous air quality monitoring stations and lack of disclosure of plant by plant pollutant emissions.

Cumulative impacts for all Iskenderun Bayshould be modeled: Air quality modeling is conducted within a radius of 9 km of Hunutlu power plant where several settlements andSugözü Power Plant (bird fly distance 1.8 km) are considered. However, Atlas Power Plant (bird fly distance 33 km), Tufanbeylipower plant and several heavy industry facilities in Iskenderun Bay have not been considered in the air quality modeling, thus the cumulative pollution assessment had been conducted superficially.

CONCLUSION AND DEMANDS

Despite all the challenges in health data and lack of research on the link between public health and environmental pollution in Adana and in Iskenderun Bay[5], worldwide accepted scientific evidence clearly shows the negative impacts of environmental pollution, especially air pollution, on human health.

- **Air quality standards must be binding:** Ambient air pollution in Adana exceeds bothnational and international limit values. However these values were set to protect public health, we demand limit values to be legally binding.
- **Emission data should be disclosed: Plant by plant pollution data of large combustion plants** should be disclosed. **Continuous Emission Measurement System of** Ministry of Environment and Urbanization should be publicly accessible.
- **Health impacts should be assessed:** Health Impact Assessment (HIA) composes of a set of methodologies, methods and tools that systematically evaluates potential impacts of a policy, plan, program or a project, in terms of public health and distribution of these impacts within the society[6]. According *the WHO's estimations* effective environmental and health interventions in Europe can reduce total mortality rates by almost 10%. *Considering* its location and structure, a HIA should be conducted for the Hunutlu Power Plant.
- **The EIA report and generation license for theHunutlu Power Plantshould be cancelled:** Hunutlu Coal Power Plant started construction without a health impact assessment and with an EIA report that refers to outdated air quality limits. Moreover, engagement to prevent new coal plants has a long history in the region, which has been neglected; for instance, in 2019 local and national NGOs in Turkey repeated their demand for cancellation of the plant based on its negative impact on the marine ecosystem and marine turtles[7].

NOTES

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5 HEAL, 2016, Toolkit: Coal power generation and health in Iskenderun Bay

6 HEAL, 2020, Health Impact Assessment Briefing

7 Press release in April 2019, https://www.env-health.org/chinese-private-company-wants-to-build-a-coal-power-plant-on-protected-beach-in-iskenderun-bay-turkey/