

INVESTIGATION OF SUBWAY COMMUTERS' PM_{2.5} EXPOSURE AND COPING MEASURES IN BEIJING SUBWAYS

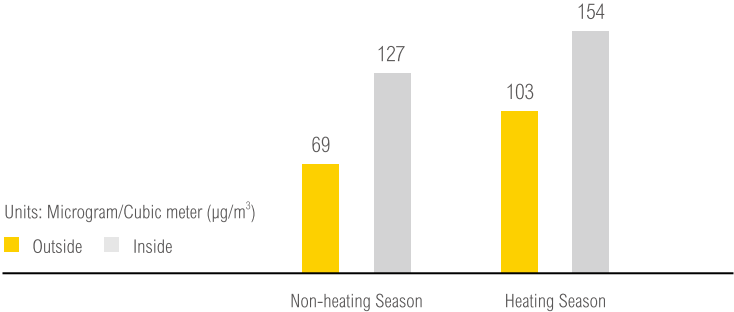


磐石环境与能源研究所
ROCK ENVIRONMENT AND ENERGY INSTITUTE

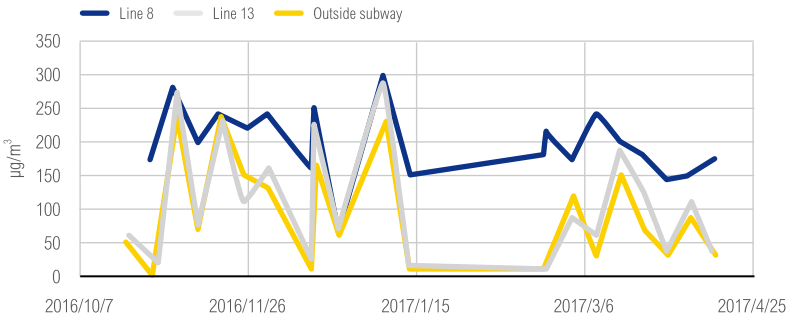
Beijing's 10 subway lines with largest commuter population: Line 1,2,3,4,5,6,8,9,10,13,14.
 Air pollution monitoring devices: AIR BEAM
 Time Frame: Observations made every Friday evening for 22 weeks (October 14th, 2016- January 13th 2017 and February 21st, 2017 to April 14th, 2017)

MONITORING RESULTS

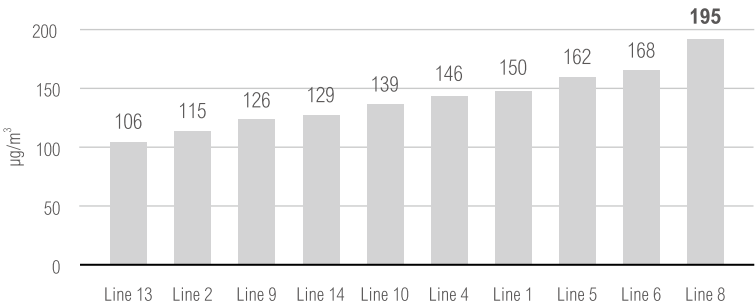
No matter heating season or non-heating season, the concentration of PM_{2.5} in the subway is higher than the outdoor air during the observation period.¹



The concentration of PM_{2.5} in the subway is positively correlated with the concentration of PM_{2.5} outside the subway.



During the observation period, the PM_{2.5} concentration on Line 8 reached the highest level, with Line 13 being observed the lowest concentration of PM_{2.5} at 106 $\mu\text{g}/\text{m}^3$, but still far above the level of national second-level standard of ambient air quality (annual average of 35 $\mu\text{g}/\text{m}^3$).



SURVEY APPROACH

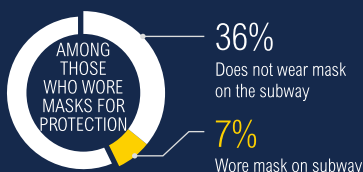
In-person interviews conducted by Peking University students
—A total of 618 valid questionnaires were collected.

PUBLIC AWARENESS OF AIR POLLUTION AND CORRESPONDING BEHAVIORAL CHARACTERISTICS

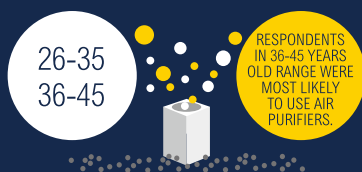
1. 76% of respondents believed that air pollution concentrations outside the subway were worse



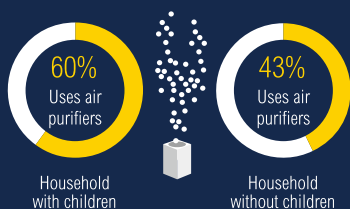
2. Respondents who never wore masks totaled 36%, who always wore masks totaled only 7%.



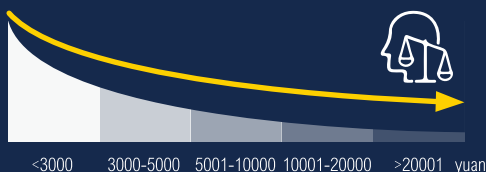
3. Individuals from the ages 26-35 and 36-45 were both likely to use air purifiers, but the largest proportion of air purifier uses were in the age range from 36-45.



4. Around 60% respondents with children are more likely to use air purifiers, in contrast to 43% for respondents without children.



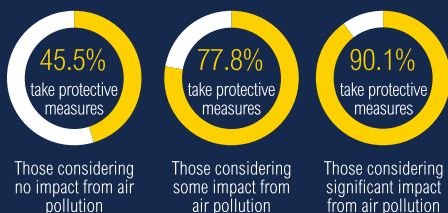
5. The higher income of the respondents, the lower percentage considered consumers should take responsibility for air pollution



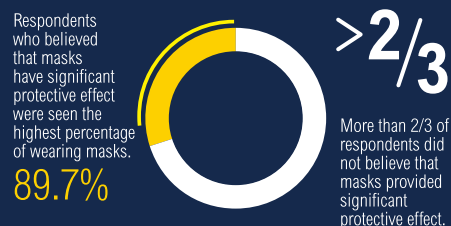
6. If thinking personally affected by air pollution, more women would take protective measures.



7. The larger impact felt by respondents for air pollution, more protective measures were taken.



8. If individuals considered that masks have significant protective effect, they were more likely to wear one.



WILLINGNESS TO PAY

1. Willingness to pay for renewable energy



2. Comments on masks and willingness to pay for masks

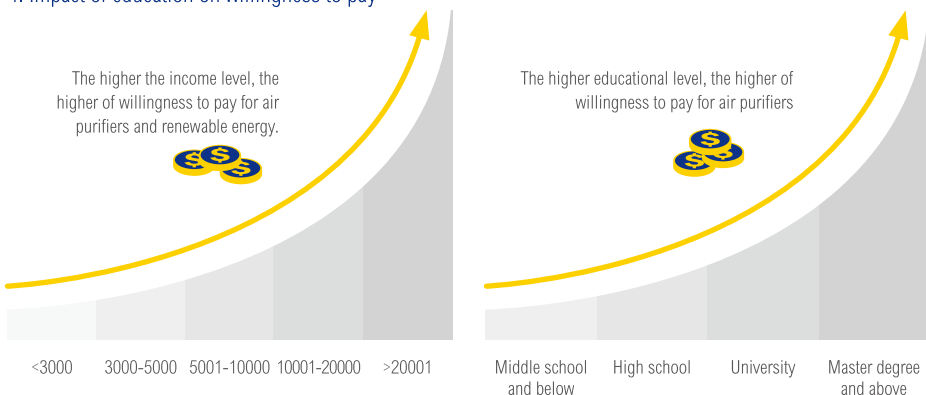
A total of 199 people think that masks have a significant protective effect, among whom those respondents would pay below 50 RMB for a anti-smog mask were seen the largest percentage, accounting for 90.1%.



3. Relationship between commuters' gender and willingness to pay

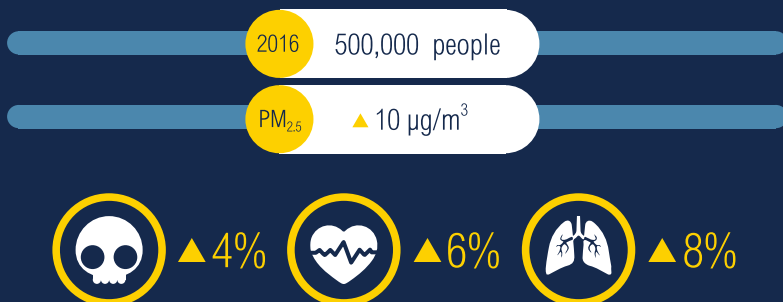


4. Impact of education on willingness to pay



HEALTH RISKS

1. According to a 16-year cohort study of 500,000 people in the United States, the death risks from all-cause mortality, poor cardiopulmonary function and lung cancer increased by 4%, 6% and 8% respectively for each $10 \mu\text{g}/\text{m}^3$ increase in $\text{PM}_{2.5}$ concentrations.²



2. During the monitoring period, the average concentration of $\text{PM}_{2.5}$ in the subway during the winter heating season and part of the non-heating season were $154 \mu\text{g}/\text{m}^3$ and $127 \mu\text{g}/\text{m}^3$, respectively.

Note: The average concentration of $\text{PM}_{2.5}$ in the subway is $127 \mu\text{g}/\text{m}^3$, which is $54 \mu\text{g}/\text{m}^3$ higher than the daily average of $73 \mu\text{g}/\text{m}^3$ in Beijing in 2016 as per Beijing Municipal Environmental Monitoring Center.

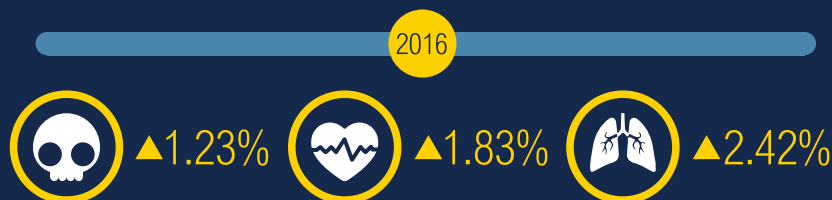


3. The survey respondents take the subway to work every day and are exposed to $3.12 \mu\text{g}/\text{m}^3$ of $\text{PM}_{2.5}$ concentration per day.

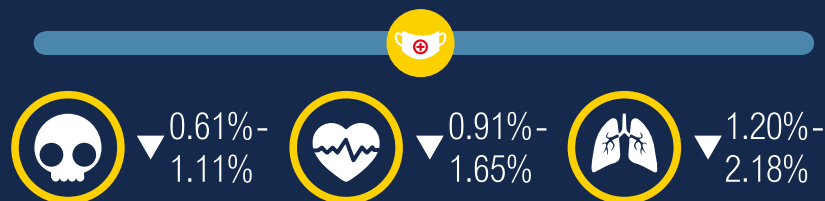
$3.12 \mu\text{g}/\text{m}^3$
PER DAY

According to the survey results, the respondent's weekly ride frequency was 10 times per week; a one-way subway ride averaged 1 hour, then round-trip exposure of 2 hours a day and 5 days a week; Chinese official holidays are 11 days. The increased exposure is calculated according to the above assumptions.

4. Riding the subway to work for 16 years can lead to the death risks from all-cause mortality, poor cardiopulmonary function and lung cancer increased by 1.23%, 1.83%, 2.42%, respectively.



5. If the survey respondents were to take the subway by wearing masks all journey, the death risks from all-cause mortality, poor cardiopulmonary function and lung cancer will be reduced by 0.61% -1.11%, 0.91% -1.65%, and 1.20% -2.18%, respectively.



Note: ¹ Outdoor air quality monitoring data were from Beijing Municipal Environmental Monitoring Center.

² CA Pope III, RT Burnett, MJ Thun etc, Lung Cancer, Cardiopulmonary mortality, and long-term exposure to fine particulate air pollution, The Journal of the American Medical Association, 2002.

ABOUT ROCK ENVIRONMENT AND ENERGY INSTITUTE

The Rock Environment and Energy Institute (REEI) was established in July 2012. Since its establishment, REEI has been committed to pursuing a more inclusive, just, and sustainable society through the promotion of environmental policy, based on critical reasoning, Integrating social justice, environmental sustainability and public health. REEI produces studies and reports on the carbon market, energy policy, clean air policy, and municipal solid waste management.

Vision:

We advocate for environmental policy making mechanisms that are based on procedural justice and rational critique. We aim to make our society become more inclusive, just and sustainable.

WITH SUPPORT FROM



阿拉善SEE基金会
SEE FOUNDATION