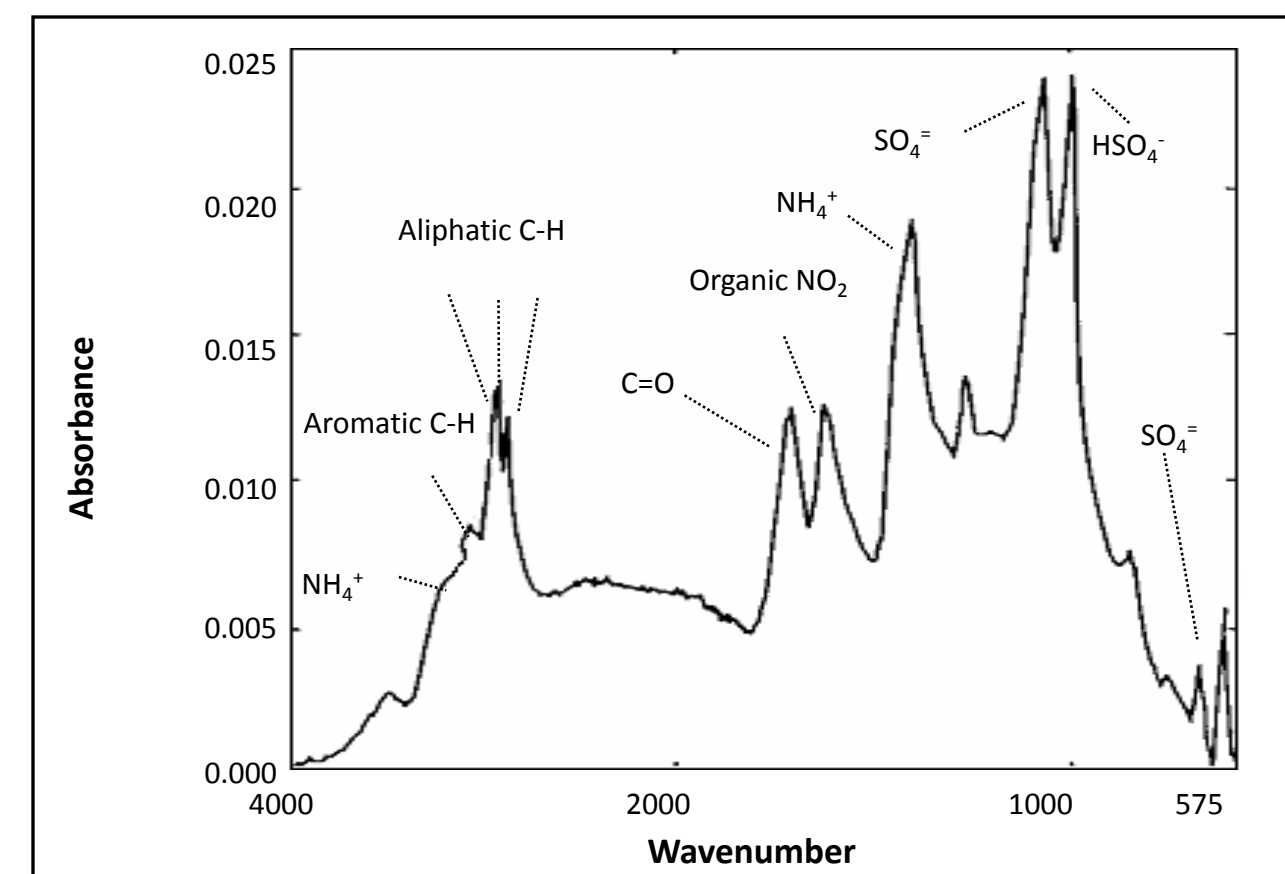
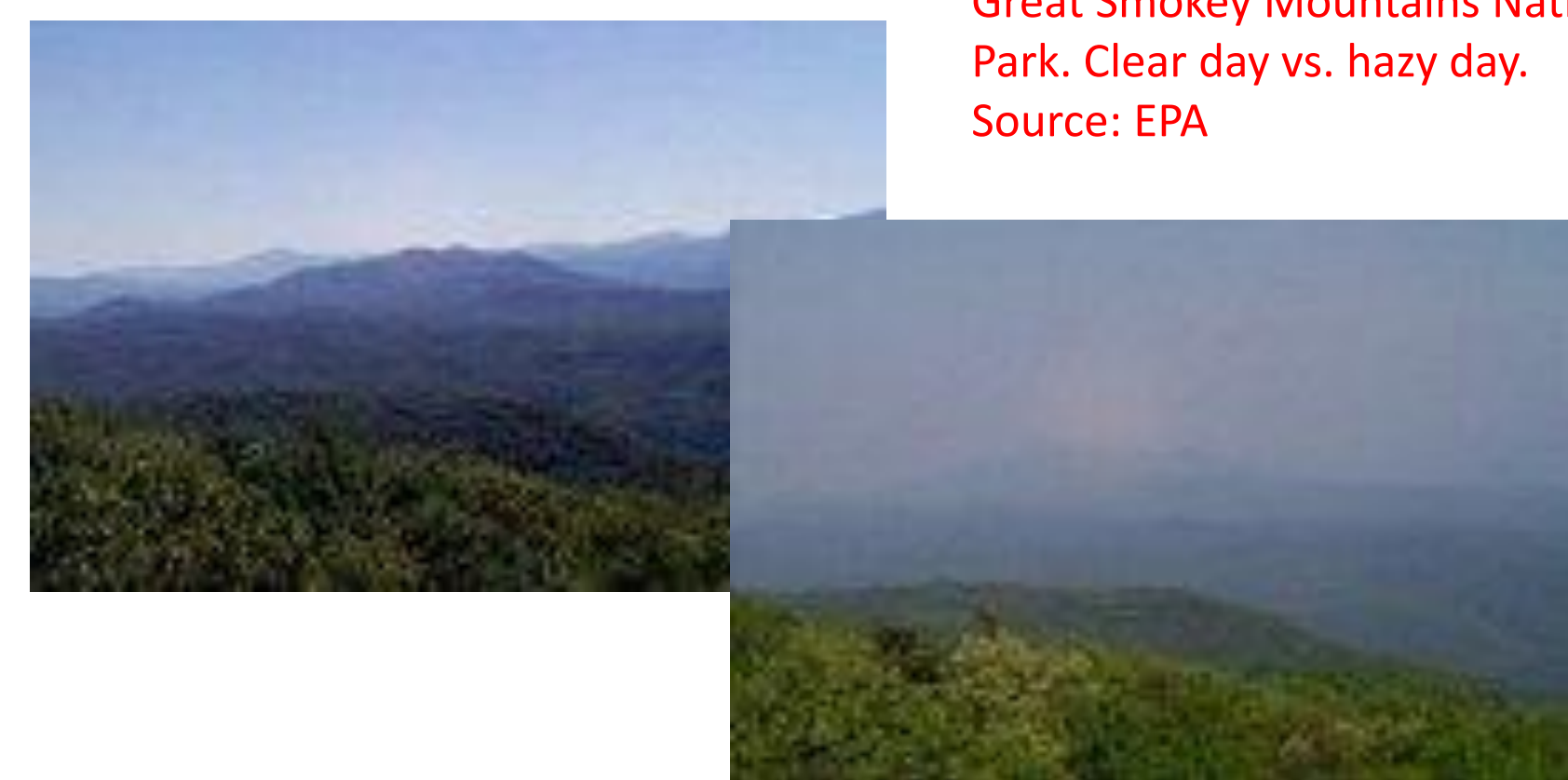


1. Background Information

Particulate matter (PM) may consist of microscopic solids and liquid droplets suspended in air. PM is made up of a number of components such as acids, organic material, metals and allergens. The mean diameter of the suspended particles ranges from a few nanometers to several micrometers. Combustion process generally produce particles with diameter less than $2.5\mu\text{m}$ (i.e. $\text{PM}_{2.5}$). Ultrafine PM, or “nanoparticles” are formed both during combustion and after emission in the atmosphere through condensation and molecular growth pathways and are less than $0.1\mu\text{m}$ in diameter ($\text{PM}_{0.1}$). PM is associated with a environmental phenomena such as haze and acid rain and wide variety of adverse health effects .



IR spectrum of ambient PM.
Source: Pickle et al, 1990



Great Smokey Mountains National Park. Clear day vs. hazy day.
Source: EPA

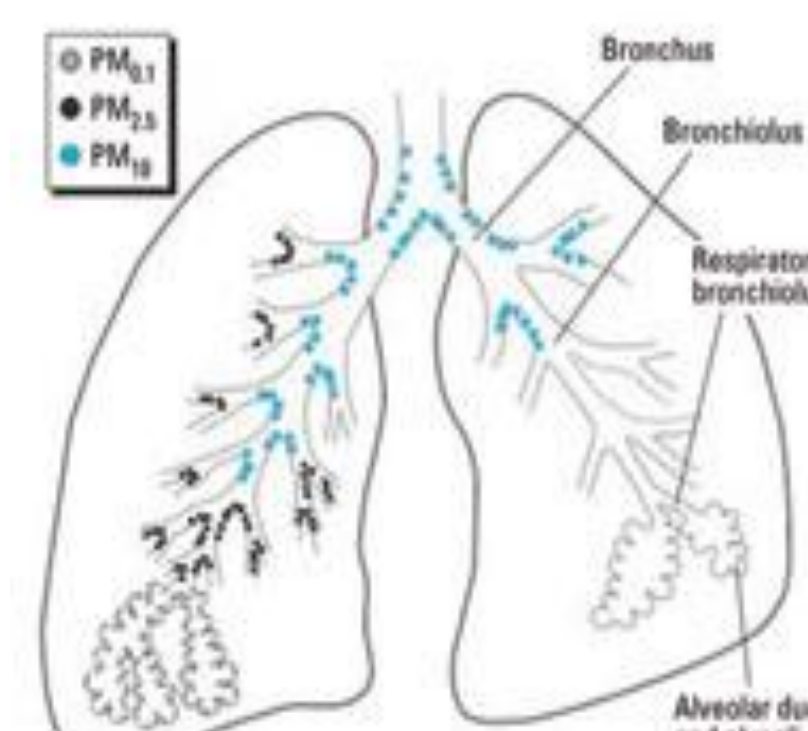
2. Health Effects

PM is small enough to be inhaled and deposited in the respiratory tract. Exposure to fine PM has been associated with pulmonary effects such as:

- Decreased lung function
- Aggravated asthma
- Increased respiratory symptoms (coughing or difficulty breathing), and
- Diminished lung function growth in children

Nanoparticles penetrate the alveolar regions of the lungs and the epithelium, which suggest that these particles affect the health of other organs.

Exposure to nanoparticles has been associated with Cardiovascular effects, cancer and reproductive effects.



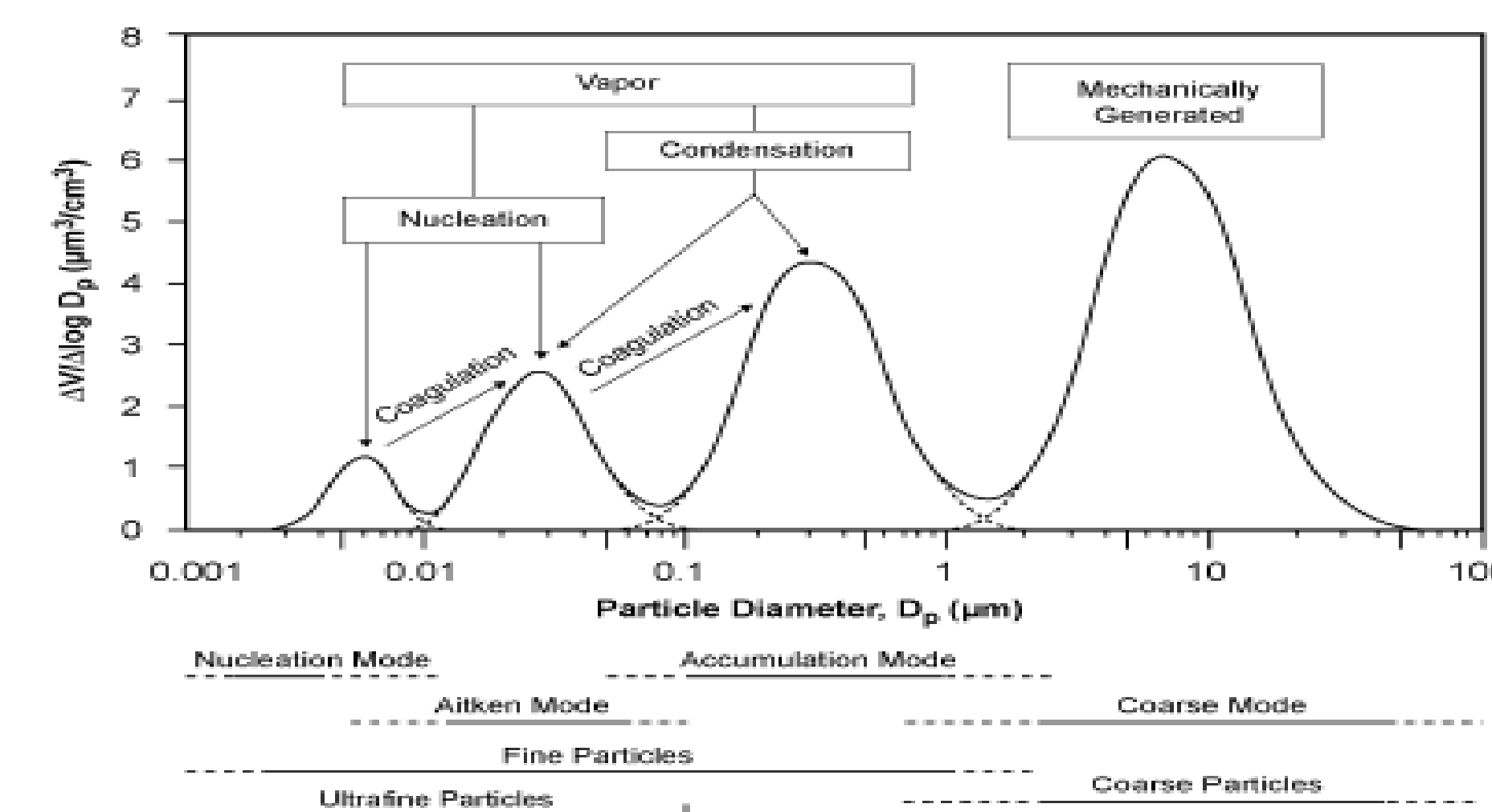
Distribution of PM in the airways.
Source: Cormier et al, 2006

3. Research Scope

- To quantify contribution of WTE plants to nanoparticles generation relative to fossil-fuel power plants and other combustion sources
- To investigate the reported health effect associated with exposure to nanoparticles

4. Research Plan

- Analysis of $\text{PM}_{2.5}$ and precursor gases emission data for conventional power plants and WTE plants. (EPA standards exist for $\text{PM}_{2.5}$ but not for $\text{PM}_{0.1}$)
- Particle size distribution (for primary PM)
- Study the chemical reactions (i.e. nucleation and condensation) that possibly lead to secondary $\text{PM}_{0.1}$ formation
- Literature research about all the known adverse health affects associated with $\text{PM}_{0.1}$ exposure



Secondary PM formation.
Source: EPA

Nanoparticle formation\growth
Source: Cormier et al, 2006

