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### Carbon Emissions Trading Simulator Using iOS Apps For E-Learning

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#### ABSTRACT

This paper presents on Carbon Emissions Trading Simulator using iOS Apps and the usage for for E-Learning. Currently, the simulation is done using computer and the trading process is not user-friendly as the market operator and the trader have to use computer to do the trading. Other than that, current method is also not environmentally-friendly as it consumes a lot of time and energy. The software named Xcode 6 is used to develop the mobile version application that is only available on Apple OS X and not compatible with Windows operating system. Objective-C is the programming language used to do the project. The outcome of this project is the mobile application which is capable to plot the bar chart from the iPhone based on the input from all traders. The urgency of the project is to create awareness for public about the how carbon emissions trading method is applied in order to control air pollution by providing economic incentives for those who succeed to achieve reductions in the emissions of pollutants. At the same time, it can give better understanding for students how the carbon emission trading is done.

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#### INTRODUCTION

Fossil fuels are burned to create energy. From fuelling our cars to keeping warm in our house, energy is used. The fossil fuels are either burned directly or it is burnt in a power station to drive turbines which generate electricity. For examples, gas is burnt in a boiler and petrol is burnt in a car (Nature Geoscience, PNAS, 2002). In year 2010, CO<sub>2</sub> emission from fossil fuel is 33.4 billion tons and this value keep on increasing each second. In year 2012, study found that 38.2 billion tons of CO<sub>2</sub> is emitted into the air and CO<sub>2</sub> emission rate increases to 2.4 million pounds of carbon dioxide every second (CBSNews. 2012).

Allowance price fluctuations can have a tremendous impact on an emitter's operation. In addition, in order to reach the ultimate reduction target, the proper allocation of allowances is very critical. Excessive allowances may weaken the incentives to pursue more efficient and cleaner generation technologies. On the other hand, insufficient allocations may have a negative impact on emitters' operations. Implementing an Emission

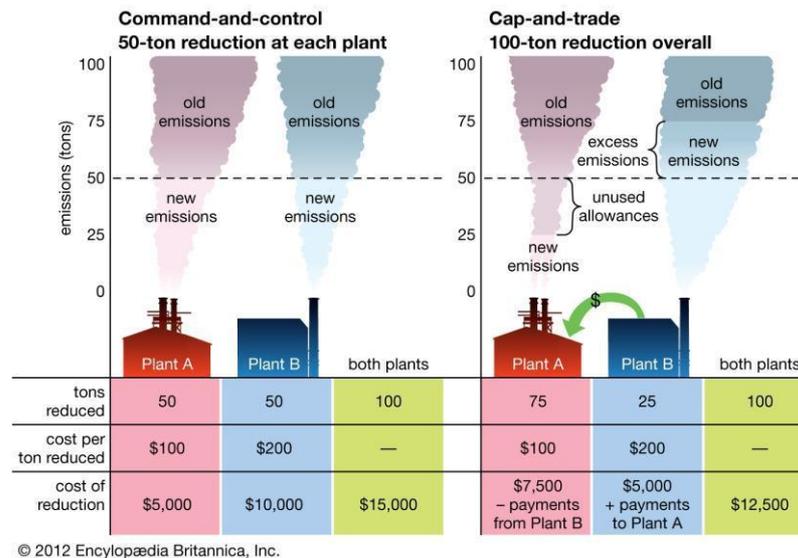
Trading Scheme will be likely to increase generation costs. Thus the impact will be on the whole energy industry (Xun Zhou *et al*, 2009).

Based on Figure 1, the total emission is 200 tons with each plant emits 100 tons of pollutants. The requirement is that these emissions must be reduced by overall of 100 tons, which is reduction of half the emission.

On the left image, in a traditional command-and-control system, to meet the overall reduction of 100 tons, each plant might be required to reduce by 50 percent. Plant A might have to spend only \$100 a ton, for a total expenditure of \$5,000. Plant B might be able to reduce at \$200 a ton, for a total of \$10,000. To reach the overall reduction of 100 tons would cost around \$15,000 for both plants.

On the right image, in a cap-and-trade system, each plant might be given allowances for only half its previous emissions. Plant A might be able to reduce emissions to as little as 25 tons where reduction costs only \$100 a ton. This leaves it with unused allowances for 25 tons of pollutants that it is not emitting.

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**Fig. 1:** Emission Trading Between Two Plants

Plant B might find it less costly to reduce to only 75 tons and then buy Plant A's unused allowances where reduction costs \$200 a ton. Plant B then effectively pays Plant A to make the 25 tons of reductions that Plant B cannot afford. The lower overall cost which is around \$12,500 where the reduction of 100 tons would still be reached compared to the command-and-control system (Environmental Economics : Emission Trading, 2015).

In addition, technologies have been massively evolved but still the relationship between technologies and education has become a large gap. The invention and innovation of electronic gadgets should have helped students in their education. Engineering student often face difficulties when they are dealing with economic theories and variables connected to their particular fields.

The Carbon Emission Trading Simulator is important in order to educate people to reduce air pollution caused by carbon emission. Fossil fuels are burnt at various stages in the process of producing electricity, products and services for consumption. Capped carbon emission is important in order to reduce greenhouse effect. Carbon Emission Trading Simulator basically covers the buyers and sellers input and what is the System Marginal Price (SMP) determined by the market operator. Joining the emissions trading, the undesirable influence on the profit would be reduced up to half. It would also become more profitable by increasing the number of trading countries in the market (Hiroyuki Tamura, Takashi Kimura, 2007).

The system used in certain company to do the trading activity usually by using computer. However this kind of method has some limitation as it is not

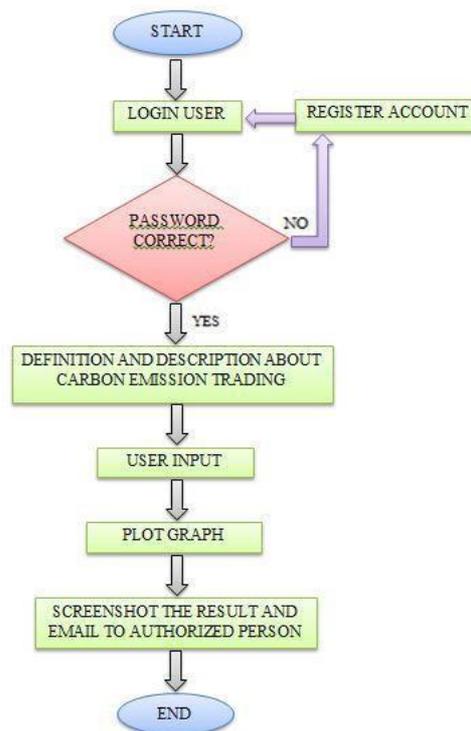
portable, hence the traders and market operator have to stick to one place to connect computer with Wi-Fi.

Therefore, this mobile application is developed in order to overcome such problems. The software named Xcode 6 is used to develop the mobile version application that is only available on Apple OS X and not compatible with Windows operating system. Xcode is a software development tool that is capable for developing application that can be used in iPhone, iPad and iPod and can only developed using MacBook. Objective-C is the programming language used to do the project. C-Objective is almost similar with Java and C language. Developer that does have experienced using C++ or C can learn C-Objective more easily as some of the syntax in both programming language are presented in C-Objective.

For this application, the user can see all buyers and seller categories where the traders can enter the amount that they want to trade. Next, the graph will be plotted automatically at the screen of the device used. Then, the user can send the data to associated email to be analyzed or reset back the data in order to perform the new analysis (Apple Developer, 2013)

#### **Methodology:**

Firstly, before starting to develop this mobile application, the developer must understand the idea of online trading and how the carbon emission trading is done. The existing computer software generates the bar chart by using the data from database. Hence, the mobile application should have the ability to generate the bar chart and additional features to make it more convenient and user-friendly.



**Fig. 2:** Flowchart of the application

Figure 2 above shows the flowchart of the mobile application in order to ensure the project can be done smoothly. Based on the flowchart, the mobile application is seen to be very convenient easy to use. In order to design and make a mobile application, a set of computer programming language skill is required to make the application perform well without any bugs.

For the first step before develop an application, the developer must identify the platform of the application can be used. As an example, there are several of platforms for smartphone such as Android and iOS. For this project, the chosen platform is iOS. So the developer needs to have a MacBook. The MacBook used running with Intel i5 processor and 2GB of RAM. So, the MacBook meets the requirement to develop an application.

The next step is the developer has to choose the software suitable for develops the application. For this project, Xcode is being chosen because it uses programming language known as C-Objective as programing language which are suitable with developer's knowledge level and very handy for the developer. In addition, it can interact with the storyboard and main class of the system. All interfaces in storyboard will be linked to the right coding in each implementation and header file (Neil Smyth, 2013).

The developer has to understand and able to develop a simple mobile application by using Xcode. Next, the developer can design the storyboard of the project. The storyboard is the graphical user interface. All storyboards have interfaces for the user

to enter the data. The storyboard design is the part of programming procedure and decoration skill is required as the developer has to assign all single button to appropriate coding and making it very easy to use and user-friendly (Mohamad Fahmi Bin Hussin *et al.*, 2014)

After storyboard had been created, then all storyboard have to be added to specific subclass and class. These classes are belongs to each of the storyboard. Then, the developer must write the suitable coding to each of the label, text field, view controller and buttons to allow all the storyboard to integrate each other and function well. This is the hardest part in the project as the Objective-C is a case sensitive. All the property in each classes and subclasses must be written in default coding that has been setup by Apple Inc. All these type classes also known as implementation and header file.

The coding written for the project consume a lot of time to be completed. A simple sign or capital/small letter can lead to error to the project. A warning symbol in the coding should be prevented as it can create error in the coding. After rewrite all the coding, then building phase took process. If there is no error in the coding, the build process will write 'build successful while 'build failed' is for wrong coding has been implemented.

In Xcode, it is user friendly to build the mobile application because it has simulator in it. The simulator can be changed to any Apple device such as iPhone with variable resolution and processor speed and also iPad. Therefore, the mobile application developer does not have to install the

mobile application into the device for each time to test and troubleshoot the coding. As a result, time can be saved when developing a mobile application. In this project, it is only used simple interface and image. Therefore, 4 inch iPhone screen is selected to be the simulator.

After completing the mobile application, all results and discussion is recorded in order to see the functionality of the mobile application.

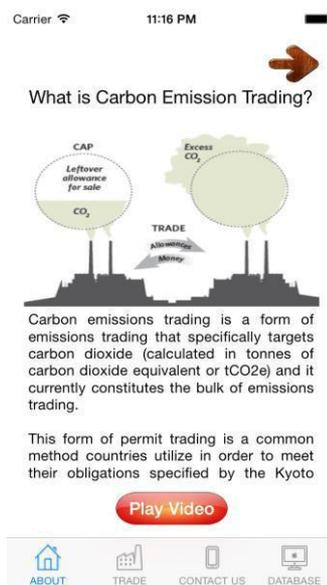
### Results:

All the results represented are the user interface in the real application. By referring to the results, the mobile application for carbon trading is successfully developed for iPhone platform. The Xcode software makes easier for developers to develop the mobile application.

For the first interface of the mobile application, it shows the user the login page. First, the user needs to enter the username and password prior doing

trading activity. This is to ensure the security of the application. After the login page, the application will direct the user to main page of the application. In order to proceed to do the trading, the user has to push the start button or on the other hand push the logout button to exit.

Then the user has three (3) options to choose from the page. The about page gives explanation to the user about definition of carbon emission trading. The explanation makes the user understand the concept of carbon trading before do the trade. In addition, user can choose to play the video from YouTube for further explanation or user can also go to the next page the watch the animation about the carbon emission trading. The carbon emission trading page linked to the main page by using tab bar controller. The tab bar controller allows the page to have four (4) tab bar options for the user. The button presented at all page must be declared first in the header file in order to make it function.



**Fig. 3:** About Carbon Emission Trading Page

The trade button in Figure 3 will direct the user to the Figure 4 which represents the user input. In Figure 4, there are twelve (12) lists shows the trading process which is divided into two (2) different categories, seller and buyer. The traders have to enter the amount of carbon emission and the price for every ton that they want to trade for a certain period.



**Fig. 4:** Buyers and Sellers input

Based on Figure 4, the plot graph button will display the bar chart shows in Figure 5 below. All bar chart can display the value as the user touch each of bar chart. The information button allows the user to confirm each bar represents each seller and buyer. Therefore, this mobile application is more convenient because it is portable and lot of features.



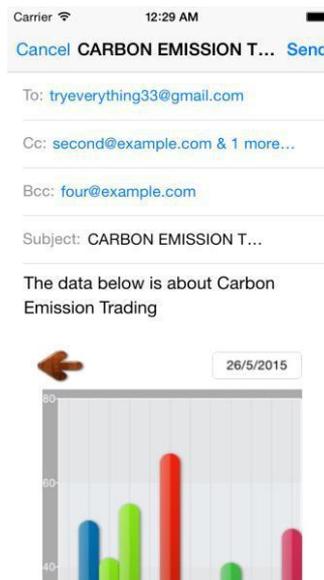
**Fig. 5:** Bar Chart of the Deviation Analysis

After bar chart has been plotted, then the user will screenshot the bar chart and sends it to corresponding email. The email content will be the respective data and the bar chart itself. Figure 17 shows how the email interface looks like. The developer has to build and at the same time modify the bar chart library first according to the need of the product outcome such as the color of background, the shape of the bar chart and the number of data in each bar chart. All bar chart is written in array coding (GitHub, Kirill Mezrin, 2013).

The user also can send it to multiple recipients. For instance, user can add another email. To build the interface, the developer has to add Framework which represents the function block to send an email use in mobile application. In Xcode, the Framework functions as a library which specified to each of mobile application that often are being used.

### Conclusion:

This emission trading simulator is a mobile version of the computer based simulator. This project is at the beginning stage on developing full features mobile application for iPhone, iPad and iPod. This application was successfully developed in order to generate the bar chart from the input data by using iOS platform instead of using Microsoft Excel. Therefore, it is very handy and efficient to use the mobile application of trading simulator to do the trading activity. However, there are some limitations whilst doing this project such as knowledge limitation and time limitation. Only those who know the Objective-C language can use the software smoothly. Otherwise, the developer needs to learn from the beginning. Besides that, the input data can be varied for any other applications that required a



**Fig. 6:** Email Interface

bar chart. Develop a mobile application using Xcode also improved a lot of programming skills in shorter period that usually took about 2 years to master a certain programming language.

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