# CHAPTER 3
# RESEARCH METHODOLOGY

WPT system applied in hydrogen generation is very useful. The schematic of WPT is shown in Figure 3. 1. There are four main parts of WPT system. PV which produces electricity from sun light acts as power supply. Power supply is connected to transmitter for generating EM field around it. Induced voltage is generated when magnetic field cuts receiver coil. Current flows to load if there is closed loop between receiver and load. In this term, electrodes, which is used to generate hydrogen process, acts as load.
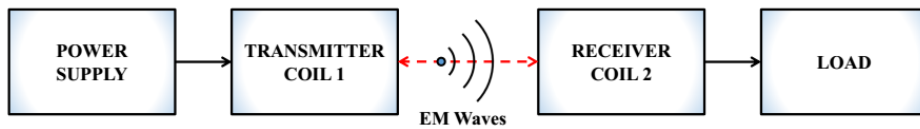


*Figure 3. 1* Simple diagram of wpt

This chapter explains about how WPT prediction can be made. This prediction is coming from the theoretical approach applying the several electrical laws, such as Biot-Savart, Faraday, Kirchoff's, and Ohm's Law. Figure 3. 2 shows the steps from the start until the end of estimation. So that, in the end of this methodology, WPT give the best performance to produce high power with good efficiency.
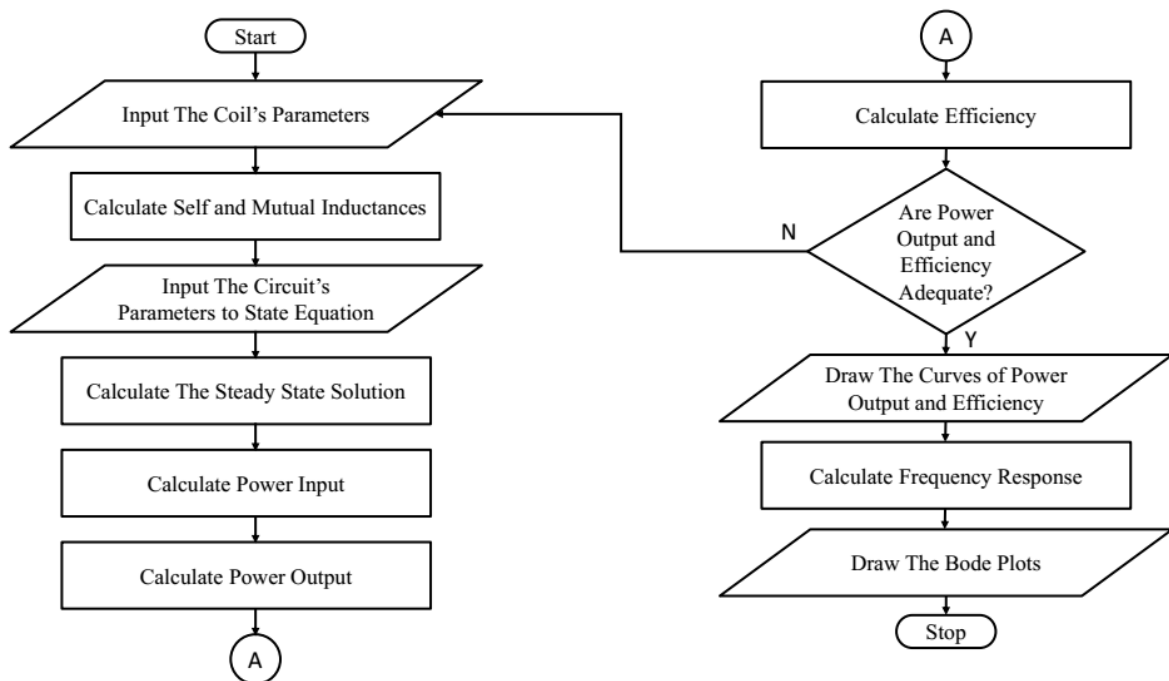


*Figure 3. 2* Flow chart of methodology

### 3.1    Defining Wireless Power Initial Parameters

Estimating the WPT parameters before building it, decrease errors in the progress. It is also helpful to perform better system. Power output is important to supply the other devices. Sufficient power output leads the system works well. First, calculate how much power which send to next device, here is hydrogen generator. This power is the estimation power output in WPT.

WPT has two separated coils. The separation means distance between those coils. It is second parameter. EM field which generated from transmitter coil is opposite in distance. More distance between those coils, more less EM field in receiver coil.

The other parameters are number of turns, coil radius, wire diameter. Coil is made from long copper wire which turn into several windings. In the circular winding, coil has radius from center to the circle. Copper wire has cross sectional diameter which varies in many sizes. Those parameters is the initial parameters which is used to compute the circuit components.

### 3.2    Calculating Circuit Components

From the parameters above, employing Biot-Savart Law, the value of self inductance and mutual inductance can be calculated. These inductances are important to do circuit analysis. Not only those inductance, but also the internal resistance of coil as well as parasitic capacitance. WPT circuit has power supply which is coming from PV and load which is hydrogen generator.

Those circuit components are calculated in state equation which solving several differential equations simultaneously. From theory about solving state equation, Steady state solution can be obtained. This steady state are in form of a matrix which contain instantaneous voltages and currents in the two coils.

### 3.3    Measurement of Power

Power is multiplication of voltage and current. In this system, power supply is sinusoidal wave and load is resistor. Calculated power is in average which instantaneous power divided by its period. Power input in WPT is multiplication of voltage and current through power supply subtracted by transmitter internal loss. While power output is multiplication of voltage and current across load.

The power output supplied to the next device may be not satisfied because it is less than the required one. This condition should be repeated from the estimation of initial parameters. Far distance and big coil radius much decrease the power output. Internal coil resistance also take part in power loss. This is why the estimation should be reconsidered.

## 3.4 Frequency Analysis

When the reactive components such as inductor and capacitor are included, the value of those reactance is depend on the frequency of the power supply. Some change of frequency in power supply affects the power input and output in WPT. Because of that, the efficiency of the system is also changed.

In a specific frequency, WPT produces maximum output. Those maximum output increase the frequency of the system. This frequency is resonance frequency. To decide how much the frequency applied in the system, frequency analysis should be done. It provides the gain of the system in respect with frequency axis.