Limitations of Moore's Law

Moore's Law (which actually is an observation rather than a law) states that the density of transistor doubles every 2 years which in turn means that computation power will increase every 2 years.

But Moore's is an exponential function and like any exponential function this will also taper down. Below are the limitations because of which Moore's Law will not continue: -

1> Power Wall

As transistor density increases so does the power consumption which in turn leads to increase in temperature. So there is a point at which further increase in density will lead to increase in temperature which will melt the chip. Hence there is a limit to which transistory density can be increased.

2> Von Newmann Bottleneck

Processors are getting faster at the rate stated by Moore's law but memory access speed is not keeping up pace with clock speed of processor. Hence CPU has to wait till the data/instruction is retrieved from memory. This limitation is called Von Newman Bottleneck which is limiting Moore's law as increasing transistor density is not really giving benefit.

3> Power Leakage

In smaller transistors the insulation is thin hence power leakage is a bigger problem in smaller transistors. So if the voltage is high power leakage will be high which is limiting Moore's Law.

4> Cooling Mechanism

Air cooling can remove a limited amount of heat. Liquid Cooling system can be used but it is impractical for desktops and laptops.

5> Noise

Generally, the voltage is not accurate. Sometimes low voltage can be 1 V and sometimes 1.2 V. In the same way high voltage can be 5 V and sometimes 4.5 V. So as the transistor size decreases this noise starts becoming a problem because it is difficult to distinguish between low and high voltage. This is called Noise problem because of which Dennard Scaling is becoming difficult and hence Moore's law is failing.

6> Electron tunnelling

Electron tunnelling prevents the length of a transistor gate from being smaller than 5 nm. This means transistors cannot be minimized below a certain dimension.