The Evolution of the Electron Transport Chain
It’s difficult to figure out the events that led to the development of the mitochondria 1.5 billion years ago because:

• Protein does not fossilize

• DNA does not fossilize
Nevertheless, there are many variations of electron transport chains and ATP synthases in nature that give us clues as to how the ETC first formed
There are bacteria that use electron powered proteins to do work in the cell.
Some bacteria have proton pumps, and the protons are captured by NADPH like in photosynthesis.
Purple sulfur bacteria have both ATP synthase motors and H+ proton pumps but not a membrane to hold the H+ like in the mitochondria.
Stage 1: pumps that use up ATP evolved to pump H+ protons out of the cell to help maintain the cell’s pH

Stage 2: Pumps powered by electrons evolved to pump H+ protons out of the cell

Stage 3: Both now work together. The ATP Synthase motor now works in reverse to make ATP instead of use it up