Mammals possess at least two distinct types of thermogenic fat cells, brown adipocytes and beige adipocytes, that play a key role in the regulation of systemic energy homeostasis. Both brown fat and beige fat possess thermogenic properties in addition to common morphological and biochemical characteristics, including multilocular lipid droplets and cristae-dense mitochondria. Recent studies also identify distinct features between the two types of thermogenic fat cells, such as their developmental regulation and function. Of particular interest is the role of beige fat in the regulation of glucose homeostasis and tissue homeostasis beyond its conventional thermogenic mechanism via uncoupling protein 1 (UCP1). I will discuss recent progress regarding the adipose tissue heterogeneity, i.e., the existence of developmentally and functionally distinct populations of thermogenic fat cells and the underlying mechanisms.