We present a dynamic acoustic analysis of over a century of changes in price, mouth, face and goat in New Zealand English. We consider these diphthongs as parts of a system evolving as a coherent whole, and present a non-parametric analysis of full formant contours using generalised additive models. Our oldest speakers show an unremarkable system: price/mouth start with low central nuclei, while face/goat start with mid front/back nuclei; both sets of vowels end in high offglides (front for price/face and back for mouth/goat). This system undergoes dramatic restructuring over the course of 100 years. The final system consists of vowels that are all similar in height, but show (i) a broad distinction between centring diphthongs with lengthened nuclei (price/mouth) and closing-fronting diphthongs (face/goat); (ii) different starting points but identical endpoints in price and mouth; and (iii) face and goat distinguished mainly by a difference in frontness.