This paper proposes a novel image-retargeting algorithm that can retarget images to a large family of non-rectangular shapes. Specifically, we study image retargeting from a broader perspective that includes the content as well as the shape of an image, and the proposed content and shape-aware image-retargeting (CASAIR) algorithm is driven by the dual objectives of image content preservation and image domain transformation, with the latter defined by an application-specific target shape. The algorithm is based on the idea of seam segment carving that successively removes low-cost seam segments from the image to simultaneously achieve the two objectives, with the selection of seam segments determined by a cost function incorporating inputs from image content and target shape. To provide a complete characterization of shapes that can be obtained using CASAIR, we introduce the notion of bhv-convex shapes, and we show that bhv-convex shapes are precisely the family of shapes that can be retargeted to by CASAIR. The proposed algorithm is simple in both its design and implementation, and in practice, it offers an efficient and effective retargeting platform that provides its users with considerable flexibility in choosing target shapes. To demonstrate the potential of CASAIR for broadening the application scope of image retargeting, this paper also proposes a smart camera-projector system that incorporates CASAIR. In the context of ubiquitous display, CASAIR equips the camera-projector system with the capability of retargeting images online in order to maximize the quality and fidelity of the displayed images whenever the situation demands.