Abstract Nowadays, natural hazards and extreme events bring about significant losses in various infrastructures including integrated electric power and natural gas networks. Thus, a robust approach is necessary for investment and operation planning of integrated energy systems. This paper presents a novel tri-level planner-disaster-risk-averseplanner framework for investment planning in integrated electric power and natural gas networks (PDP-PEN) under extreme events. The notion of the information-gap decision theory (IGDT) as a proficient non-deterministic optimization technique under severe uncertainty is utilized to enhance the resilience of the integrated system under different types of extreme events in electric power and natural gas networks through a specific parameter named as the budget of resilience. The proposed PDP-PEN framework is solved by means of a tri-level algorithm including (1) first-level: planning problem under normal condition, (2) second-level: resilience evaluation under disastrous condition, and (3) third-level: risk-averse re-planning under disastrous condition using the notion of IGDT. This resilience-oriented investment planning tool is successfully implemented on the integrated Garver 6-node electric power and 8-node natural gas networks as well as the integrated IEEE 24-node electric power and 12-node natural gas networks. Case studies justify the effectiveness of the proposed IGDT-based tri-level approach to enhance the resilience of the integrated energy systems in response to extreme events.