

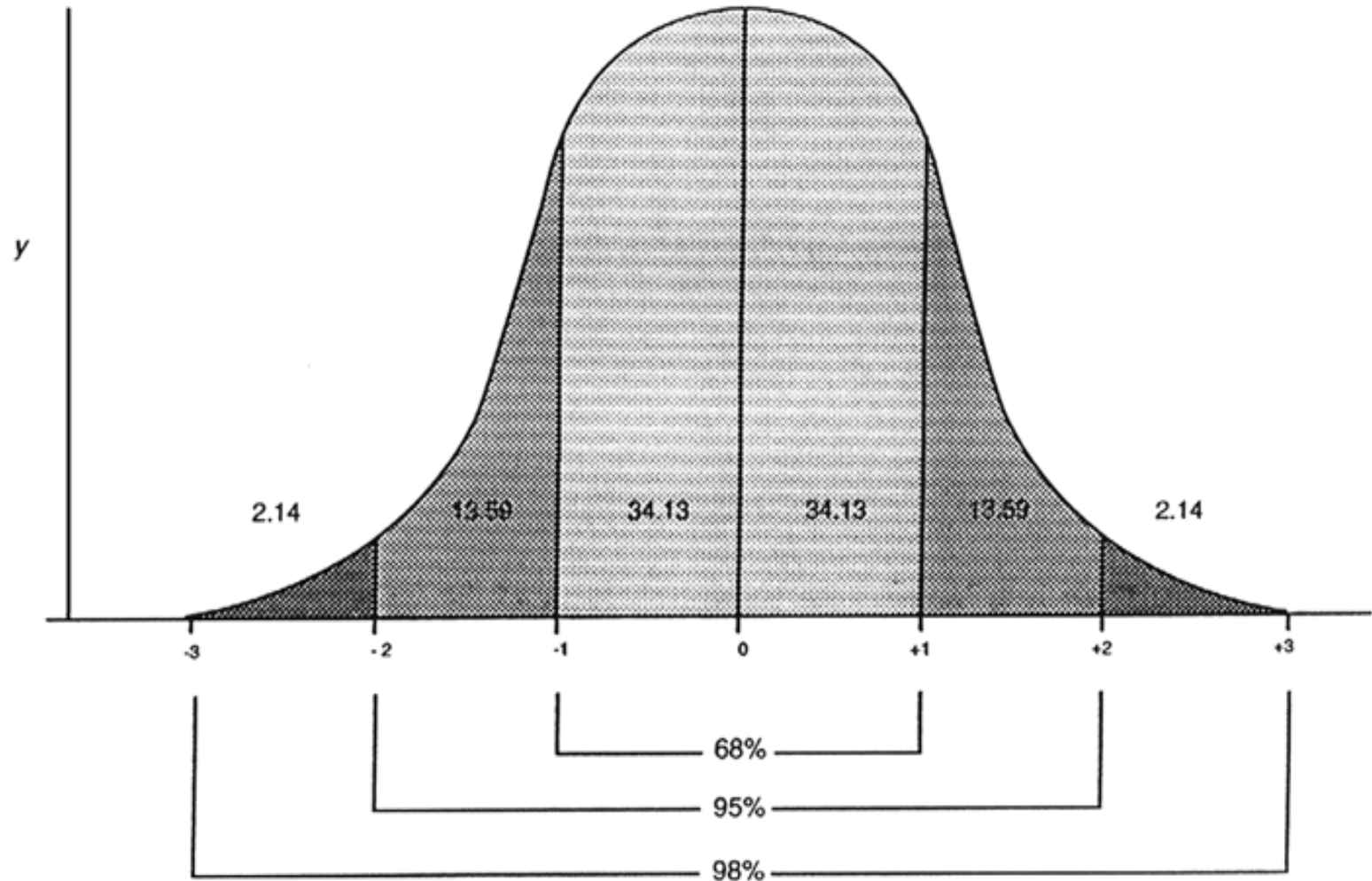
# **Risk Analysis in the NFAT**

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# What is Risk or a Risk Factor?

- Risk is associated with uncertainty and a range of possible outcomes, some good and some bad
- Modern risk analysis characterizes risk or uncertainty in terms of a probability distribution that attaches a probability to each possible outcome
- The probability distribution can, at least in principle, be quantified or estimated
- Replication methods (e.g. Monte Carlo) can be used to determine the range of outcomes for multiple risk factors interacting in complex ways as advocated by Drs. Kubursi and Magee (2010) in their independent review for the PUB of MH risk assessment practices

# Statistical Risk Analysis: Concepts



NFAT (ch.10, p.1): “it is important to recognize uncertainty and identify the way forward that has the best balance of value and risk given that uncertainty.”

- What methodology is used to analyze risk in the NFAT?
- How has the risk analysis been used to assess outcomes for alternative development plans?

# Risk Analysis Methodology in the NFAT

- Limited to Only 3 “Most Important” Risk Factors
  - Selection of risk factors based on the calculated difference in NPV for each risk factor between a “plausible high value” and a “plausible low value” for only the two development plans with the most significant difference in characteristics – the All Gas plan in pathway 1 and the Preferred Development Plan in pathway 5
  - Selection process for risk factors ignores all other pathways and plans, e.g. plans 2 (pathway 2), 4 (pathway 3), 6 (pathway 4) and 5 (pathway 5)

# Risk Analysis Methodology in the NFAT

- “Probability distributions” for each risk factor limited to only 3 points
  - Low, reference (expected) and high outcomes or scenarios
  - How are these scenarios chosen? E.g. consultant energy price forecasts for a “best estimates” and lower and upper limits of “prolonged pricing”
  - How are probabilities attached? Forecasts “combined” but some dropped
  - How can these points represent a range of outcomes of the underlying probability distribution?

# Risk Analysis Methodology in the NFAT

- The S-curve methodology plots the incremental NPV estimates for the 27 (3x3) scenarios
  - How well do these 27 points represent the cumulative probability distribution of NPV outcomes for each plan vs., say, a full Monte Carlo analysis?
  - the 27 points for each S-curve are connected linearly, ignoring more state-of-the-art curve fitting (or “smoothing”) methods

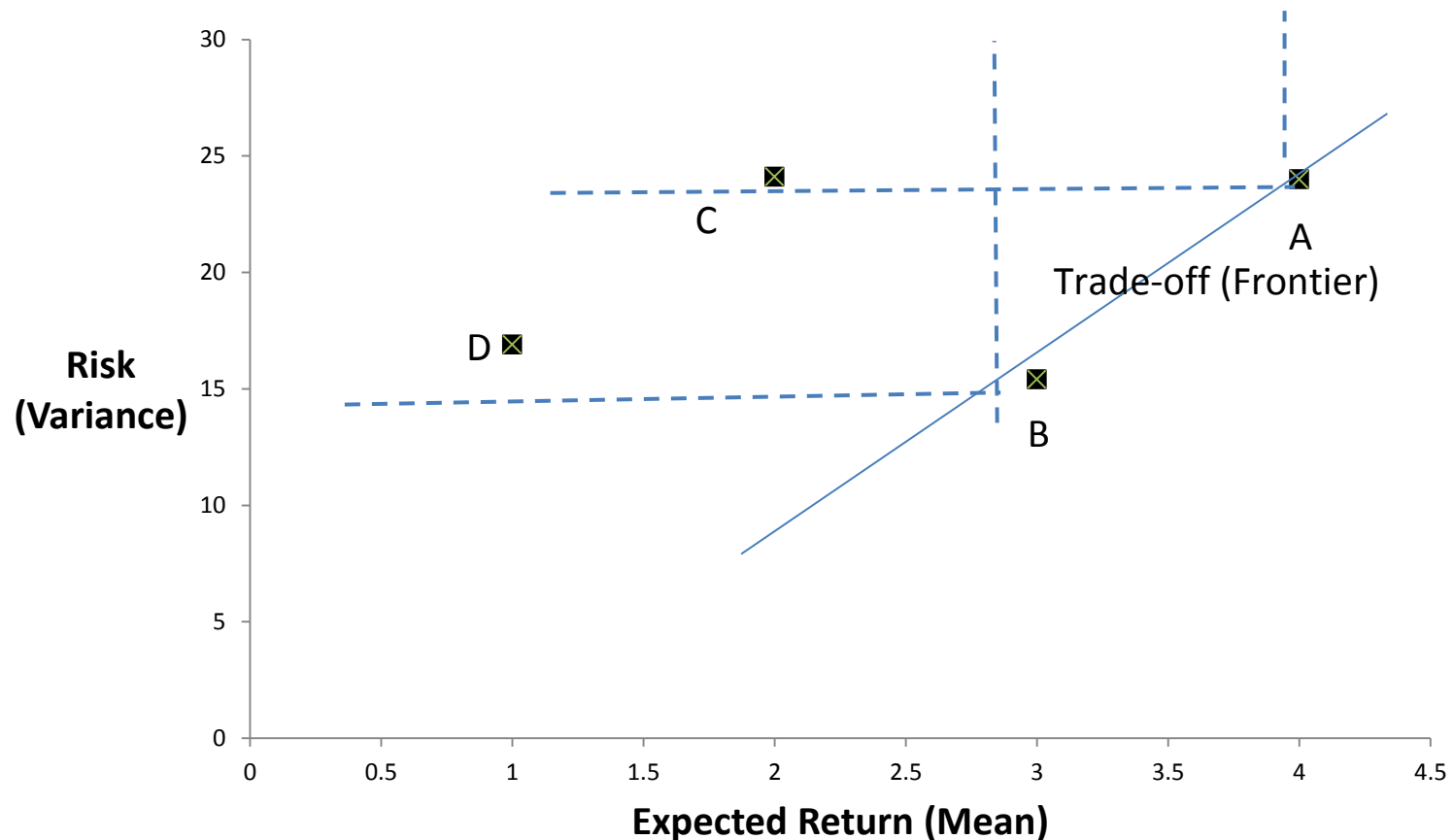
# Using the Risk Analysis to Evaluate Development Plans

NFAT (ch.13, p.68): “there is uncertainty in the reference scenario assumptions and therefore in the consequences of the different plans for Manitoba Hydro revenues and expenditures and customer rates. . . The question thus arises, does the uncertainty favour some plans over others – is there a risk trade-off that could change the relative advantage of the different plans based on the reference scenario analysis”

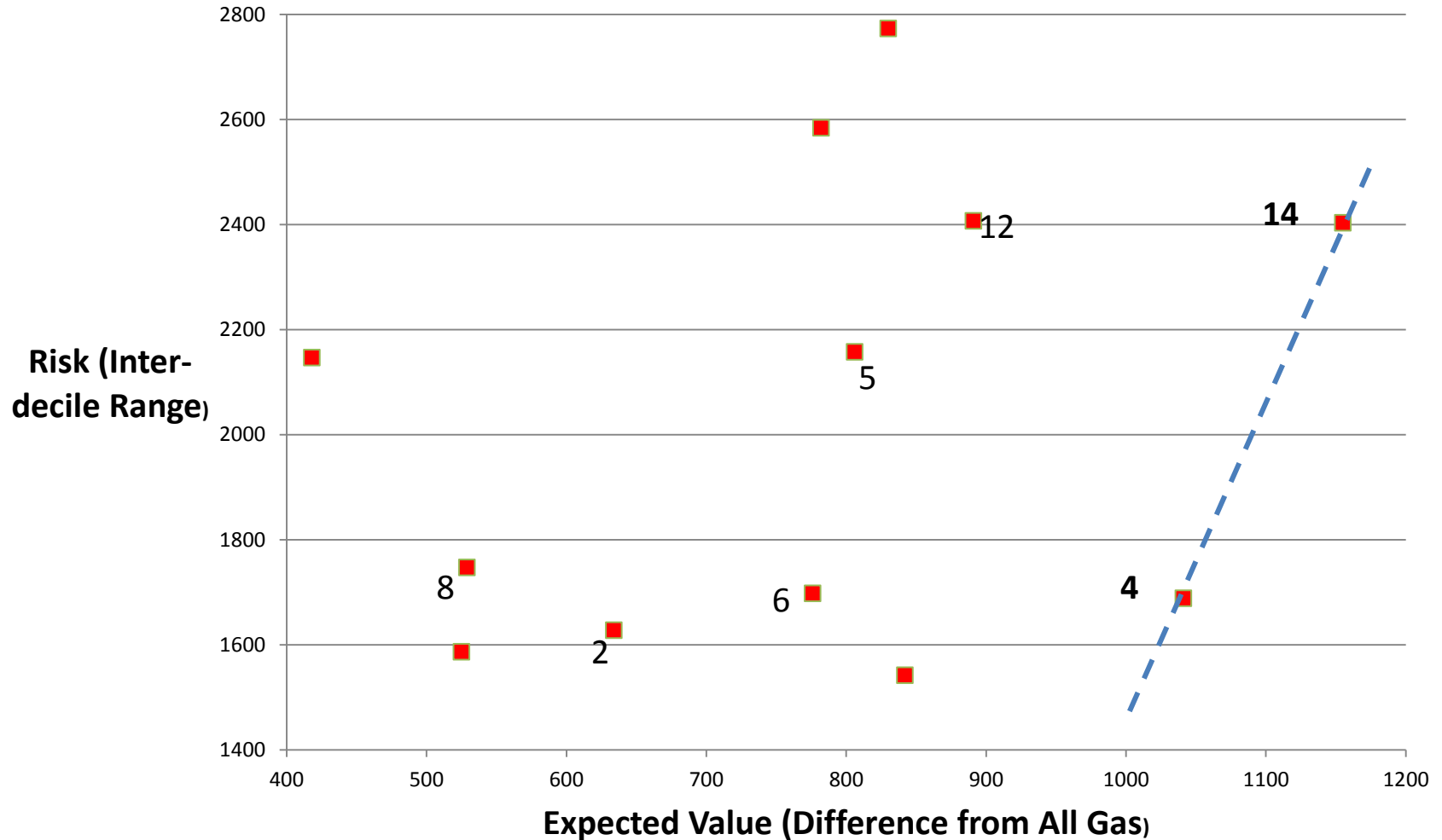


# Using the Risk Analysis to Evaluate Plans

- “risk trade-off” akin to decision between investments that differ on expected return and risk e.g. stocks and bonds (mean-variance portfolio theory)



# Using the Risk Analysis to Evaluate Plans

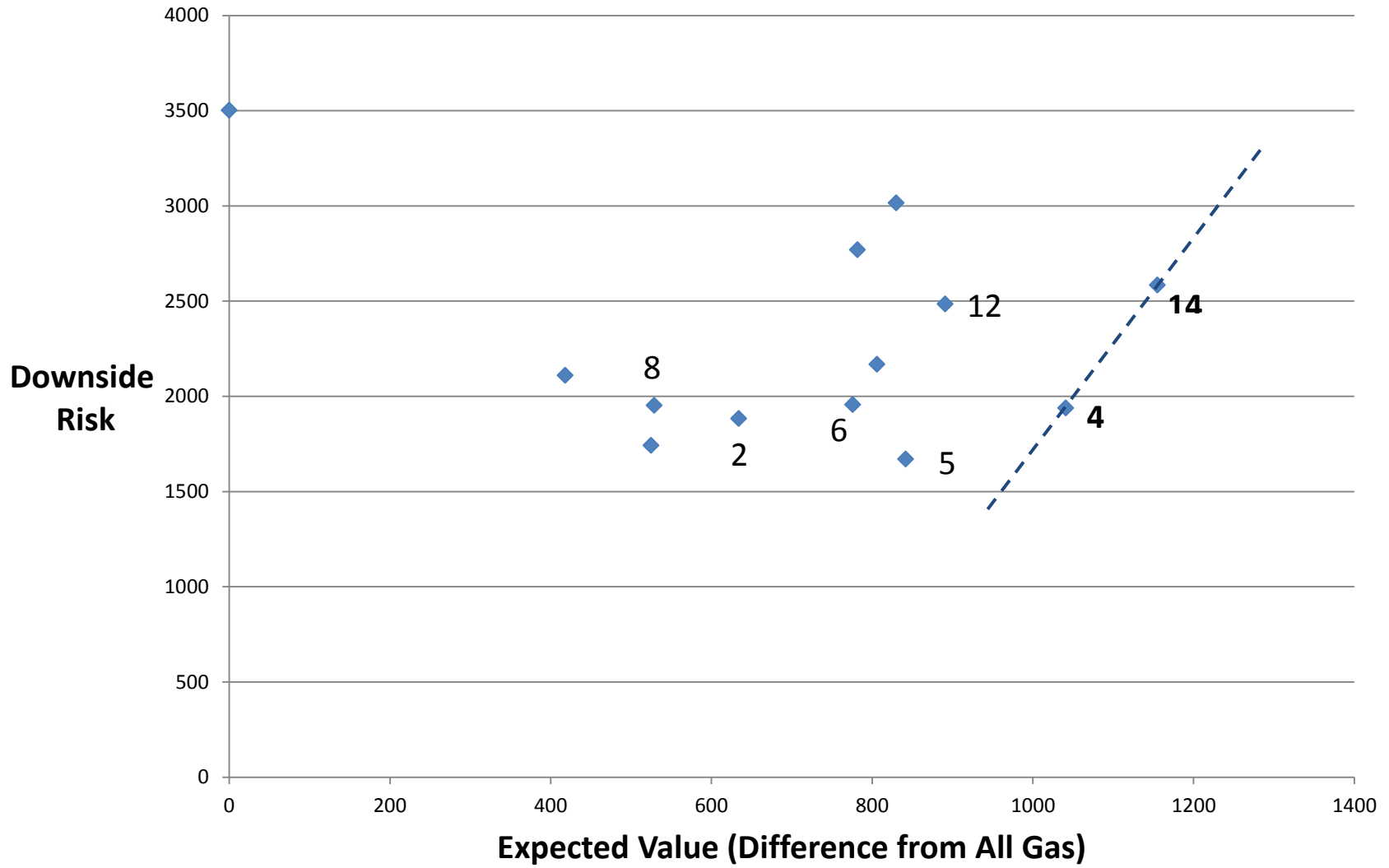


Source: NFAT Report, Table 14.2

# Using the Risk Analysis to Evaluate Plans

- Risk is about the volatility of outcomes (NPV, electricity rates), i.e. both “downside risk” and “upside potential”
- Investors prefer less volatile outcomes or want a “risk premium” (higher return) to compensate for the uncertainty
- “Loss aversion” **may** lead to a greater emphasis on “downside risk” than “upside potential”

# Using the Risk Analysis to Evaluate Plans

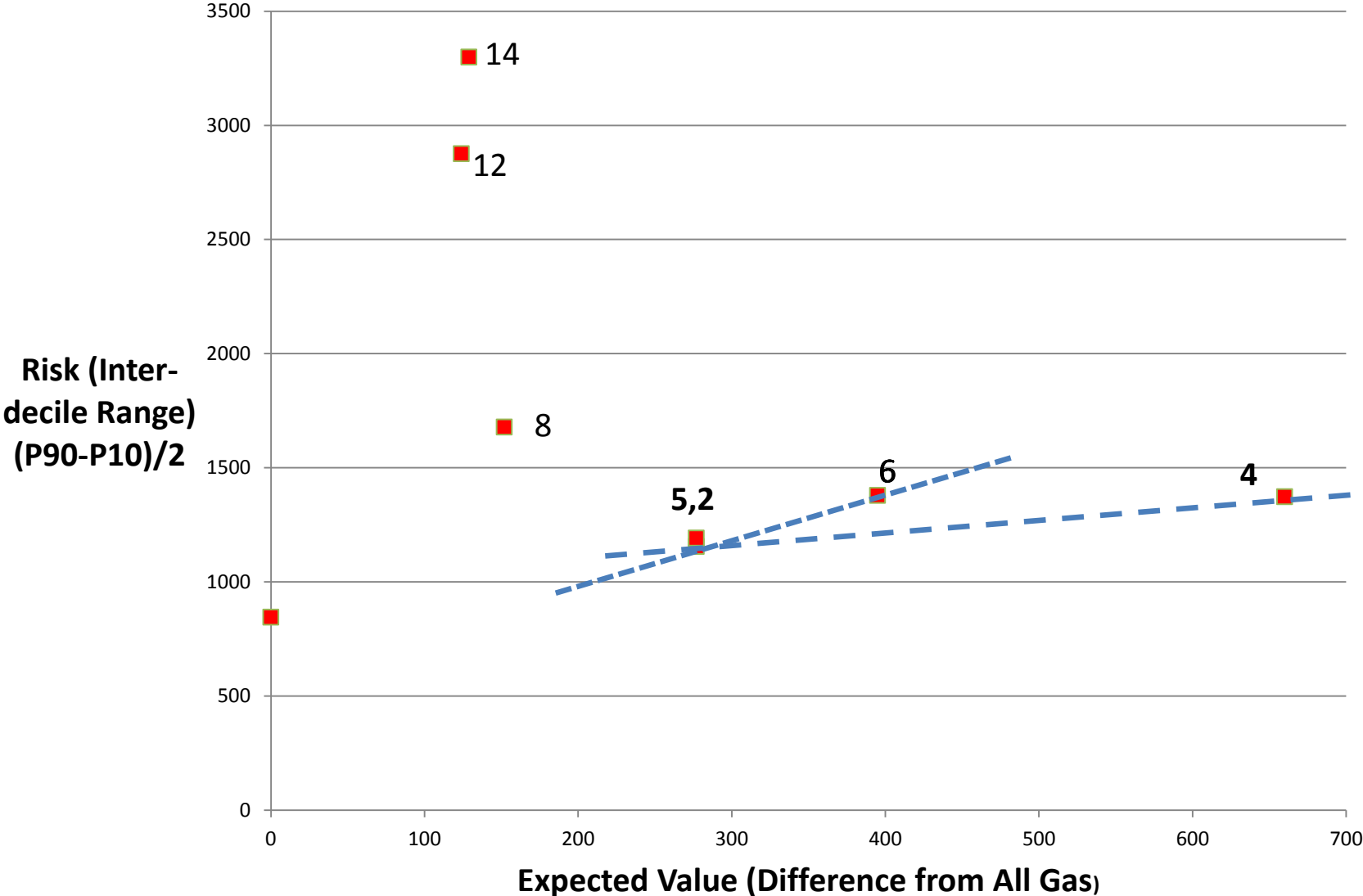


Source: NFAT Report, Table 14.2

# Using the Risk Analysis to Evaluate Plans

- Updates (MH104-8 Undertaking#27):
  - updated capital costs for Keeyask & Conawapa
  - updated probability weightings for Capital Costs factor
  - updated treatment of common factors
  - plans 5 & 14 are calculated with WPS sale but no WPS investment

# Plan Evaluation with MH104-8



# Conclusions

- NFAT risk analysis has several limitations and falls well short of analyzing all relevant risk factors with well defined empirical probability distributions as recommended by K-M (2010)
- Plan evaluation requires assessment of expected returns-risk trade-off
- NFAT plan evaluation not robust to changing cost conditions and other updates