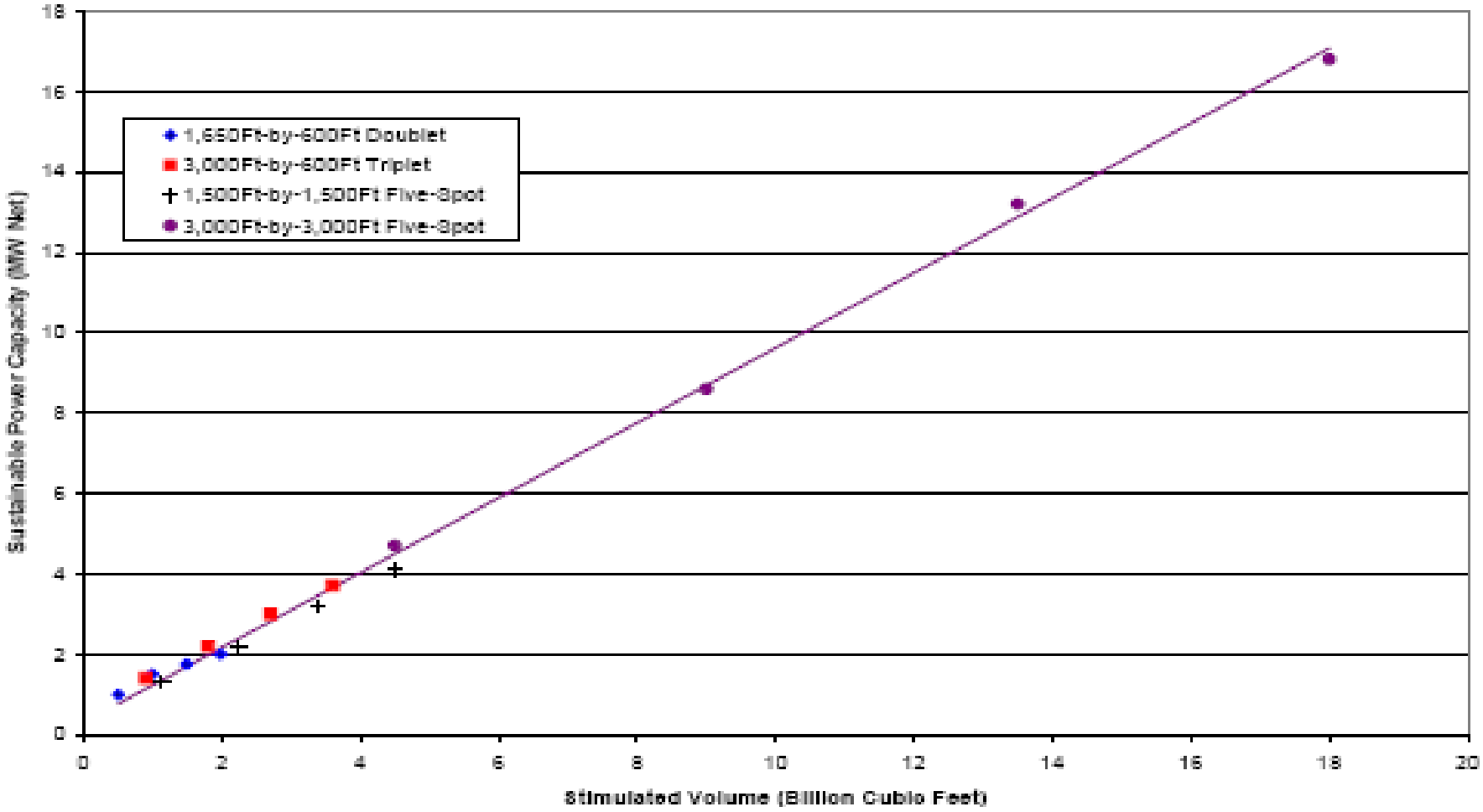
Stimulation Workshop

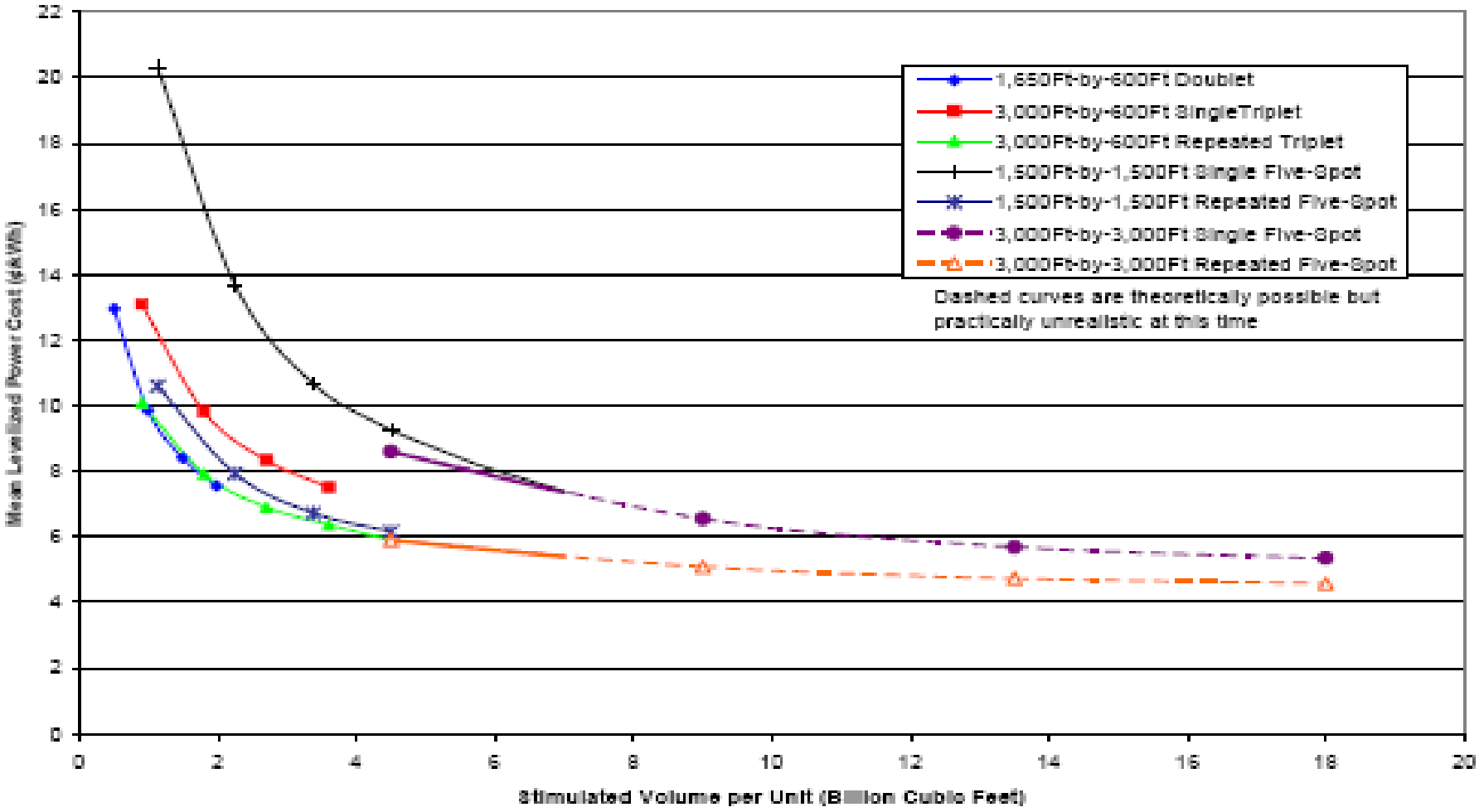
Focus on stimulation of natural fractures / joints / faults

- The context and objectives
- Some questions to be answered

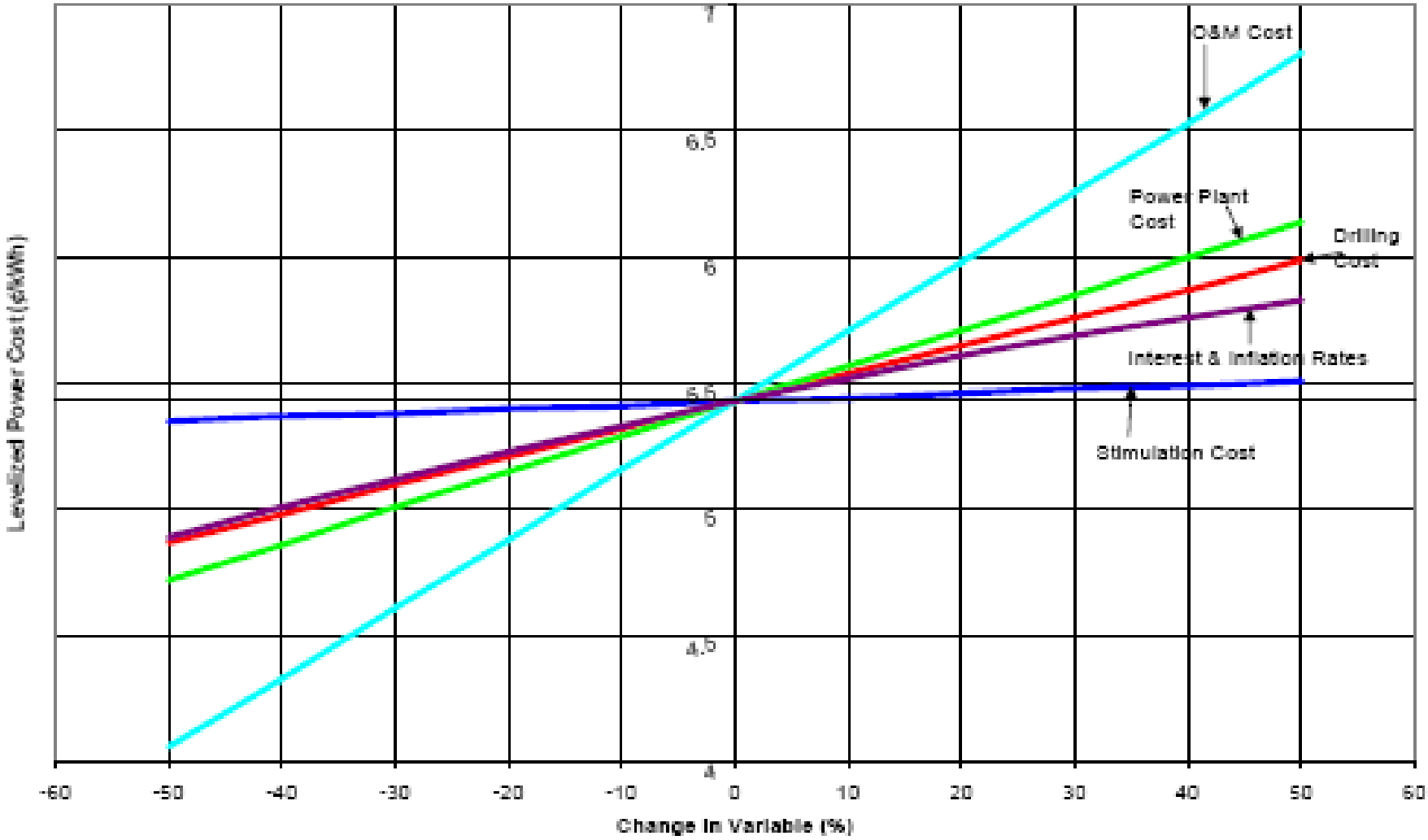
Stimulated volume drives sustainable power capacity



Stimulated volume impacts economics



Stimulation is cost-effective



Objectives

How do we meet:

- Reservoir volume objectives?
- Well productivity objectives?

And how can we assess effectiveness while the stimulation spread is in place?

Some related issues

Well bore completion and zonal isolation

- Stimulation and completion designs must match
- Logging of tight/small aperture fractures to determine isolation locations

Reservoir modelling

- What testing can be done during stimulation/while the stimulation spread is in place to assist the reservoir engineers?

Optimal procedure / process

Some detailed questions:

- Post drilling clean-up?
- Fast/slow pressure build-up
- Cycling/repeat treatment?
- Optimal fluid(s) – simple brine/gels?
- Cross-well?
- Hot/cold?
- How do we stimulate more than one fracture in a zone?

Assessing effectiveness

There is a need to:

- Assess the effectiveness of a treatment while the stimulation spread is in place
- Be clear about options if the initial indications do not meet the targets

Data sources

- Flow testing (injection/production etc)
- Micro-seismic events
- Other volume assessments

Assessing effectiveness

Extent of treatment (area, location etc)

- Established technology

Permeability distribution/map over stimulated area/volume

- Shear displacement and its correlation with permeability?
- Dilation (eg Julian and Foulger Stanford 2009)?
- An index correlated with well testing?

Assessing effectiveness

Flow testing etc

What is an appropriate procedure?

Meeting targets

What are the options to meet targets if initial indications are not adequate?

- Inadequate extent or
- Inadequate productivity

- Cycling?
- Thermal?
- Cross-well?
- Stimulation fluid?
- Pumping rate?
- Temporary diversion of permeable fractures?

An emerging issue

Near well-bore impedance

Say 25 kg/sec from one fracture (zone) implies high velocities/turbulent flow close to the well-bore. Result is unacceptable “skin factor”.

Solutions?

- Wide aperture close to well?
- More open fractures in a zone?
  - How to stimulate several fractures in one isolated zone?
- Jetting eg for 500mm, cavity completion etc