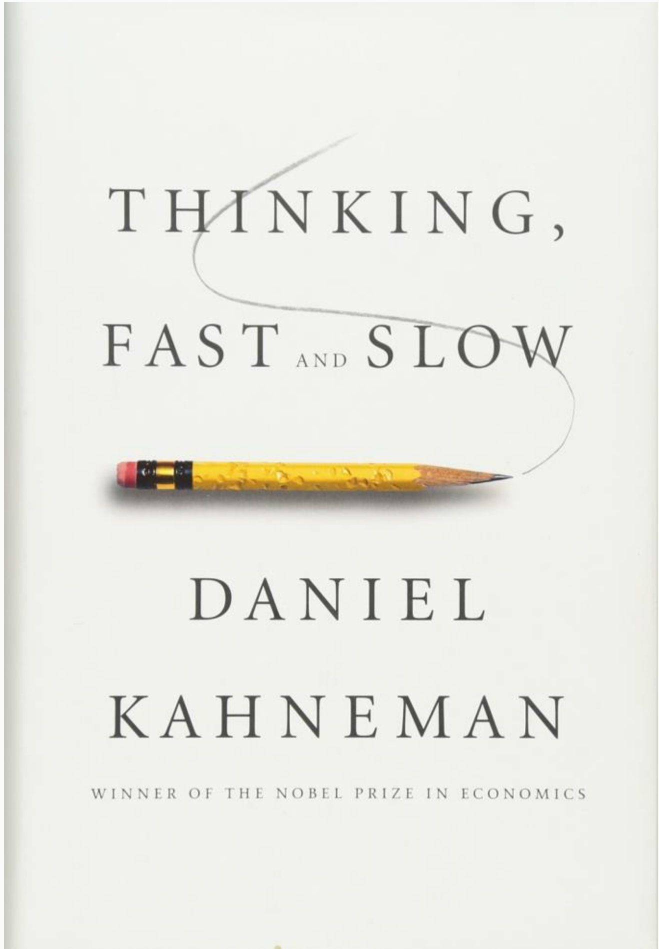
OXFORD | GLOBAL PROJECTS

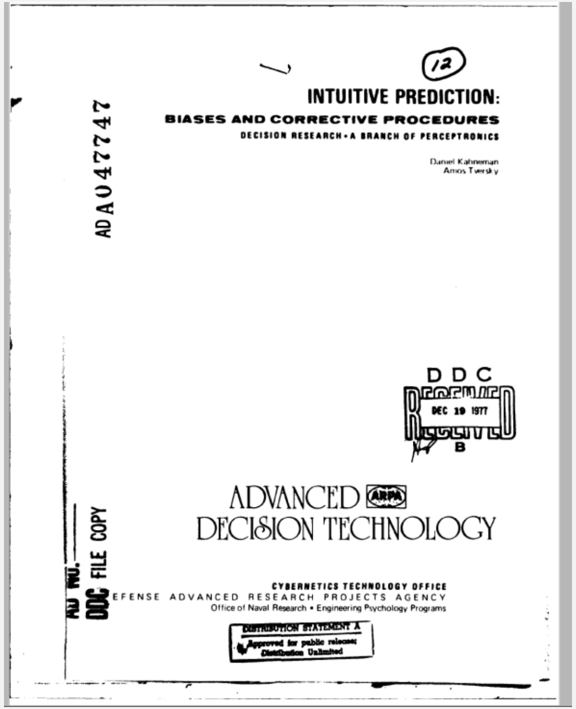
Reference Class Forecasting.

Our reference class forecasting tool has been cited by Nobel Laureate Daniel Kahneman as **“the single most important piece of advice regarding how to increase accuracy in forecasting through improved methods.”**



The Big Idea.

The **best predictor** of performance in a planned project is actual performance in class of implemented, comparable projects. Reference Class Forecasts do not guarantee accuracy, just **most accurate forecasts**. Method is based on theories that won the Nobel Prize in Economics (planning fallacy, optimism bias).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INTUITIVE PREDICTION:

BIASES AND CORRECTIVE PROCEDURES

DECISION RESEARCH • A BRANCH OF PERCEPTRONICS

Daniel Kahneman
Amos Tversky

DDC
DEC 19 1977
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ADVANCED DECISION TECHNOLOGY

CYBERNETICS TECHNOLOGY OFFICE
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
Office of Naval Research • Engineering Psychology Programs

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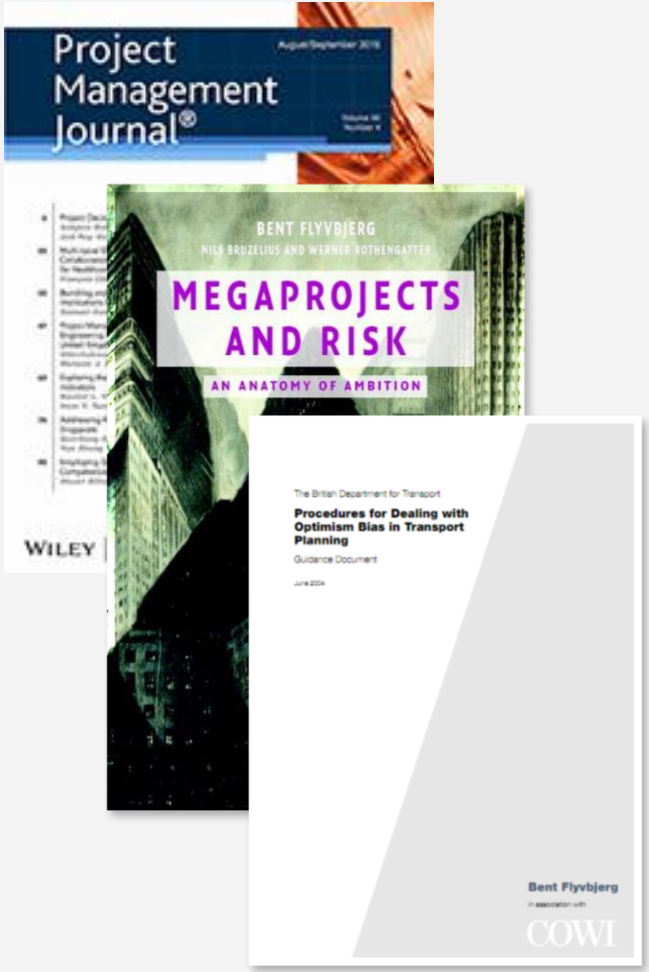
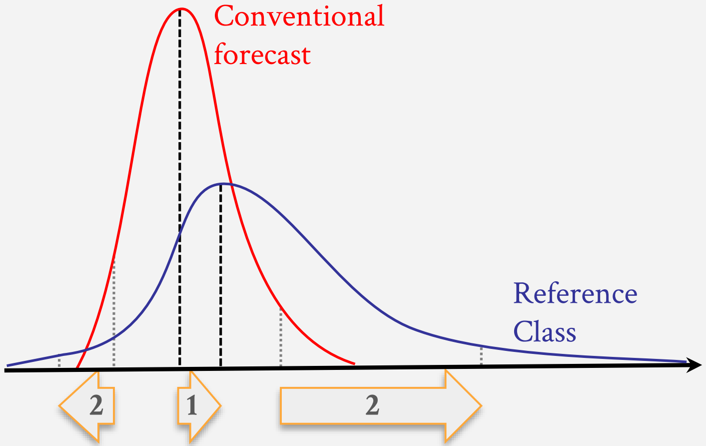
3 Steps of RCF.

1. Identify relevant reference class of past, similar projects.
2. Establish probability distribution for the selected reference class.
3. Compare specific project with distribution, in order to establish most likely outcome.



What RCF Does.

In Statisticians' language RCF regresses the best guess toward the most likely case of the reference class of past, similar projects (1) and expands the estimate of the interval to the interval of the reference class (2).



Unknown-unknowns.

RCF is the only existing method that takes into account "unknown unknowns". How? By incorporating in the reference class ALL effects on performance, including "unknown unknowns".

Defining the Reference Class Parameters.

Nuclear projects overview.

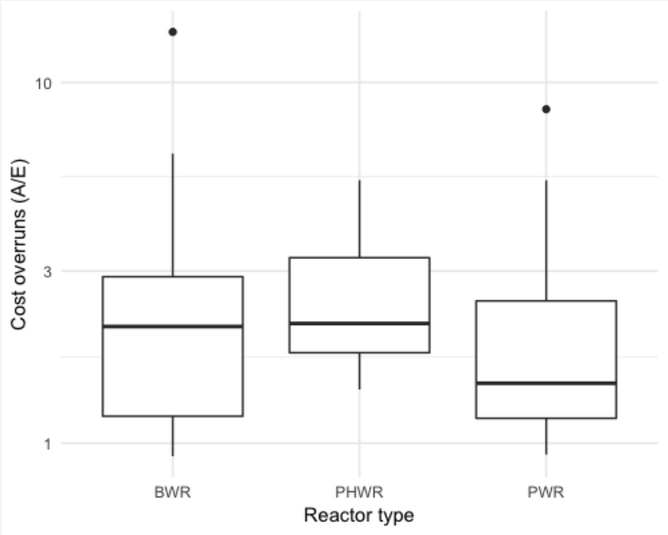
Reactor type	Measure	Cost overrun	Schedule overrun
PWR	Mean	95%	61%
PWR	Median	47%	40%
PWR	Frequency	97%	95%
PWR	N	128	121
BWR	Mean	179%	63%
BWR	Median	119%	40%
BWR	Frequency	96%	87%
BWR	N	46	46
PHWR	Mean	160%	125%
PHWR	Median	115%	142%
PHWR	Frequency	100%	91%
PHWR	N	19	11

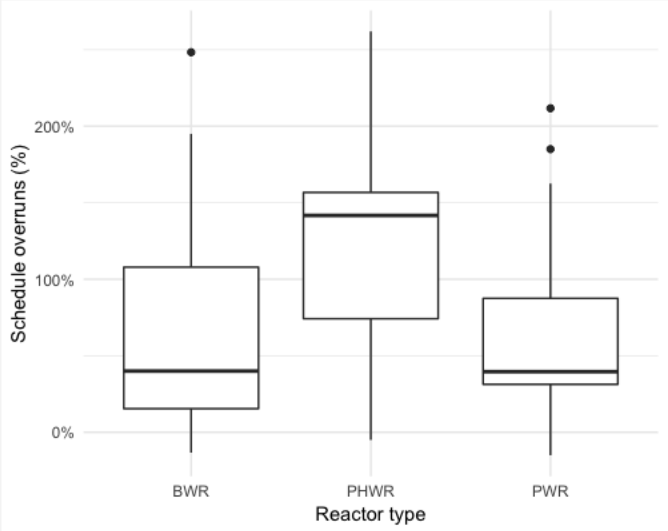
Reactor type.

The 202 nuclear new-build projects were categorized as either Boiling Water Reactors (BWR), Pressurized Water Reactors (PWR) or Pressurized Heavy Water Reactors (PHWR).

PWR reactors projects had significantly lower cost overruns than PHWR projects (p=0.0033), but there was no significant difference between BWR and PWR projects or BWR and PHWR projects.

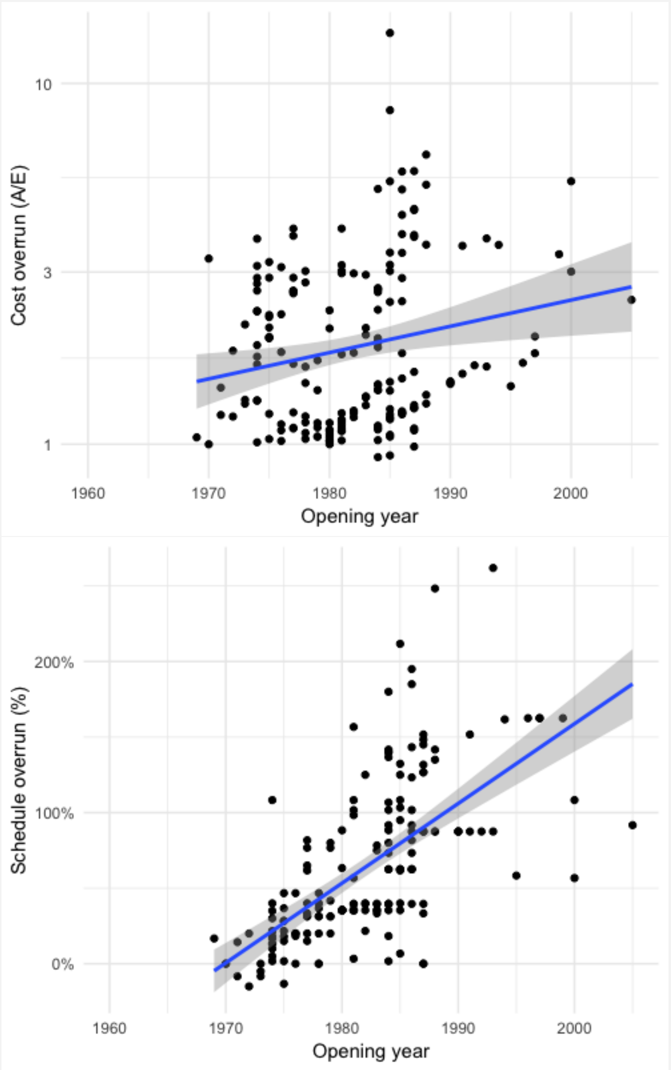
In terms of schedule overruns, PHWR projects had significantly higher schedule overruns than BWR projects (p=0.0165) and PWR projects (p=0.0093).





Opening year.

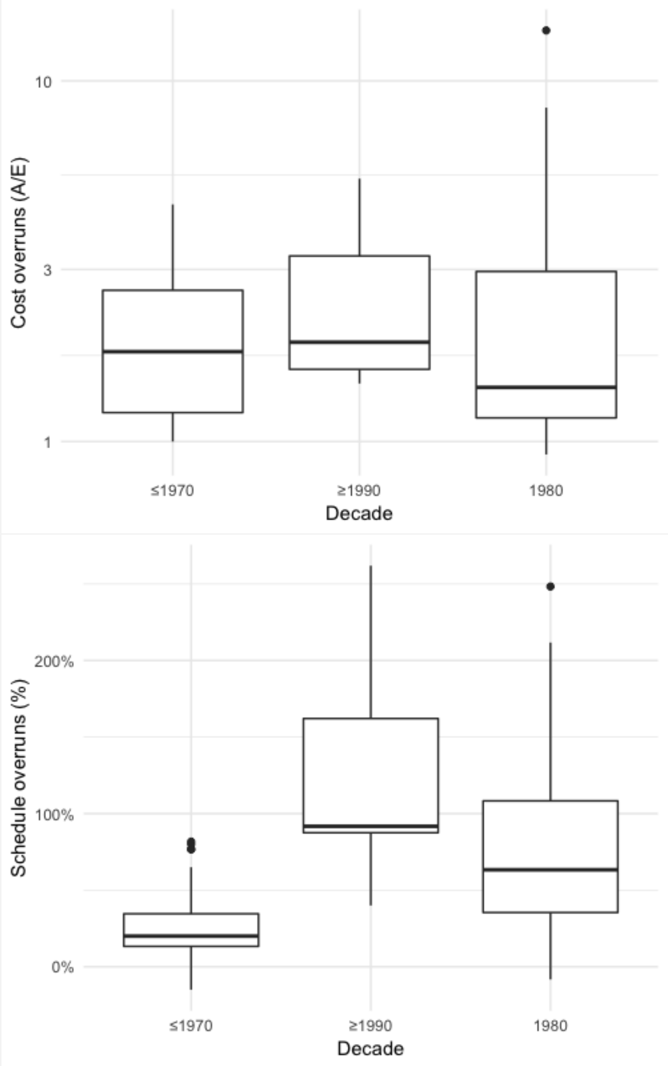
The association between opening year and cost overruns for all nuclear new-builds is statistically significant (p=0.048). The association between opening year and schedule overruns is also statistically significant (p≤0.001).



Opening decade.

To get enough observations for meaningful analysis, we bundled the opening decades into three groups, ≤1970s, 1980s and ≥1990s.

While there is no statistical significant difference in terms of cost overruns between the groups, nuclear new-build projects from or prior to the 1970s have significantly lower schedule overruns than projects from the 1980s or later. Additionally, projects from the 1980s have significantly lower schedule overruns than projects from the 1990s and later.

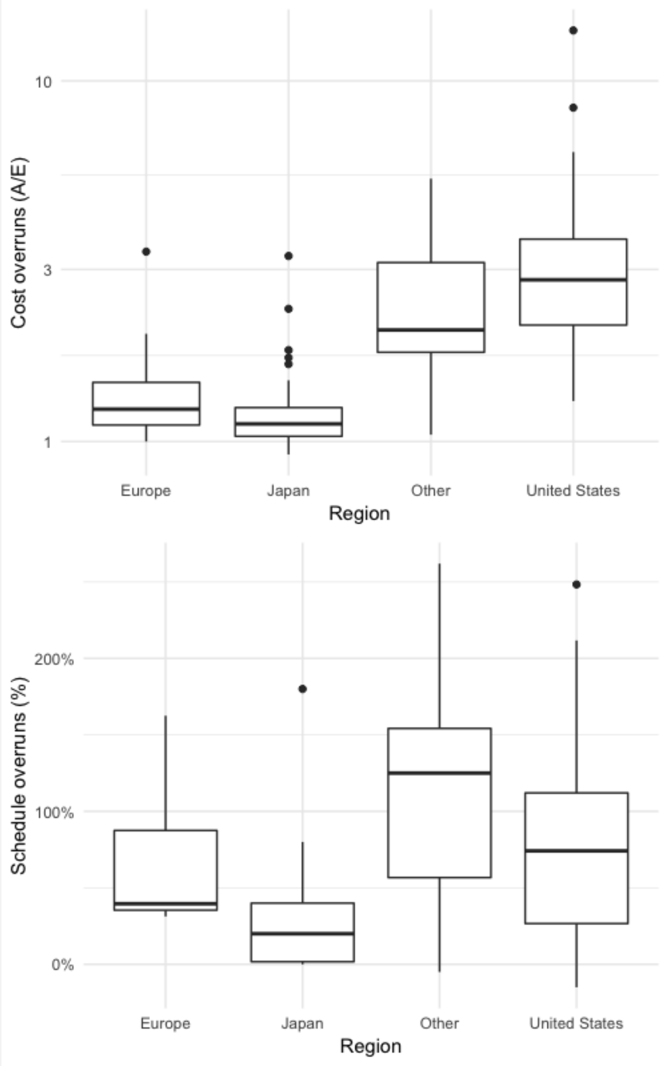


Geographical region.

In terms of cost overruns, all four groups are statistically significantly different from each other, with Japanese nuclear new-builds having significantly lower cost overruns than the other regions.

For schedule overruns, Japanese projects have statistically significantly lower schedule overruns than all other regions.

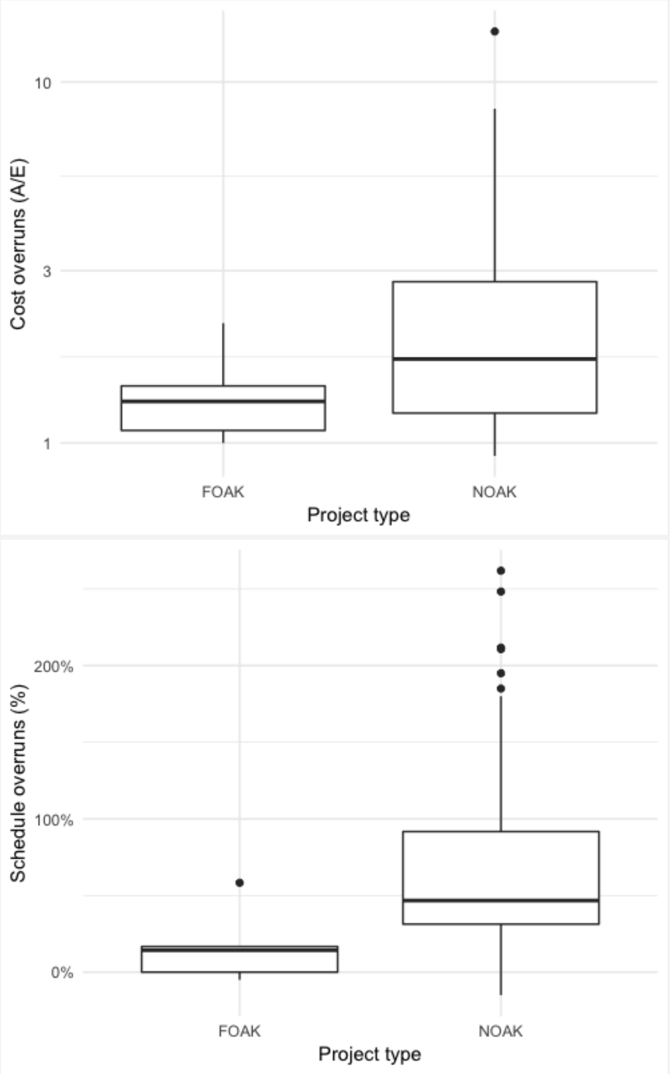
This might indicate that the broad RCF for cost overruns should exclude American projects, while the broad RCF for schedule overruns should exclude Japanese projects.



First-of-a-kind (FOAK) & Nth-of-a-kind (NOAK)

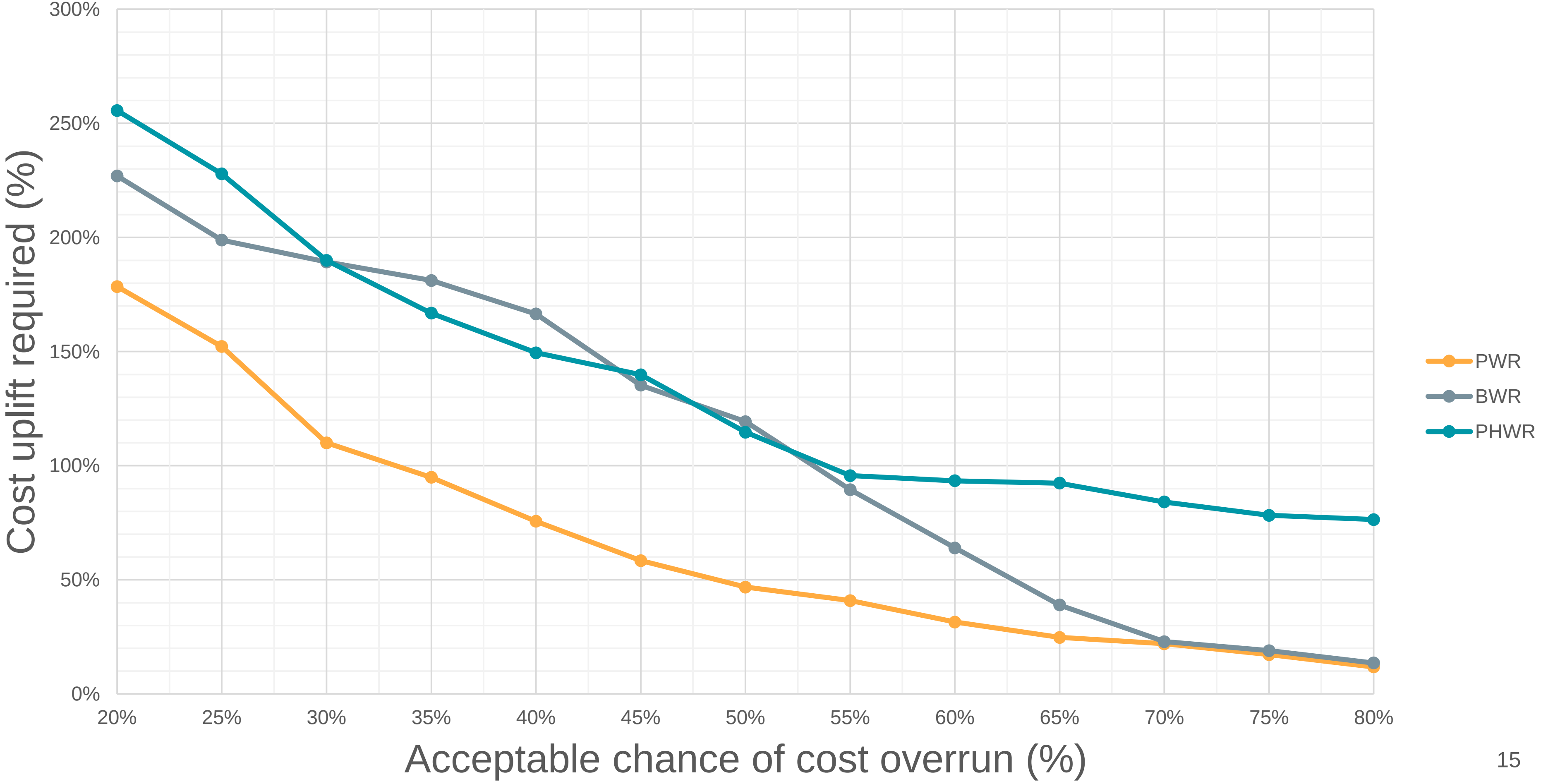
Out of the 202 nuclear new-build projects in the OGP database, we only have 7 first-of-a-kind datapoints for cost overruns and 5 first-of-a-kind datapoints for schedule overruns. This is too few datapoints for the reference classes to provide reliable estimates.

We do not see a significant difference between FOAK and NOAK projects in terms of cost overruns. However, the FOAK projects seem to perform significantly better than the NOAK projects in terms of schedule overruns (p=0.011).

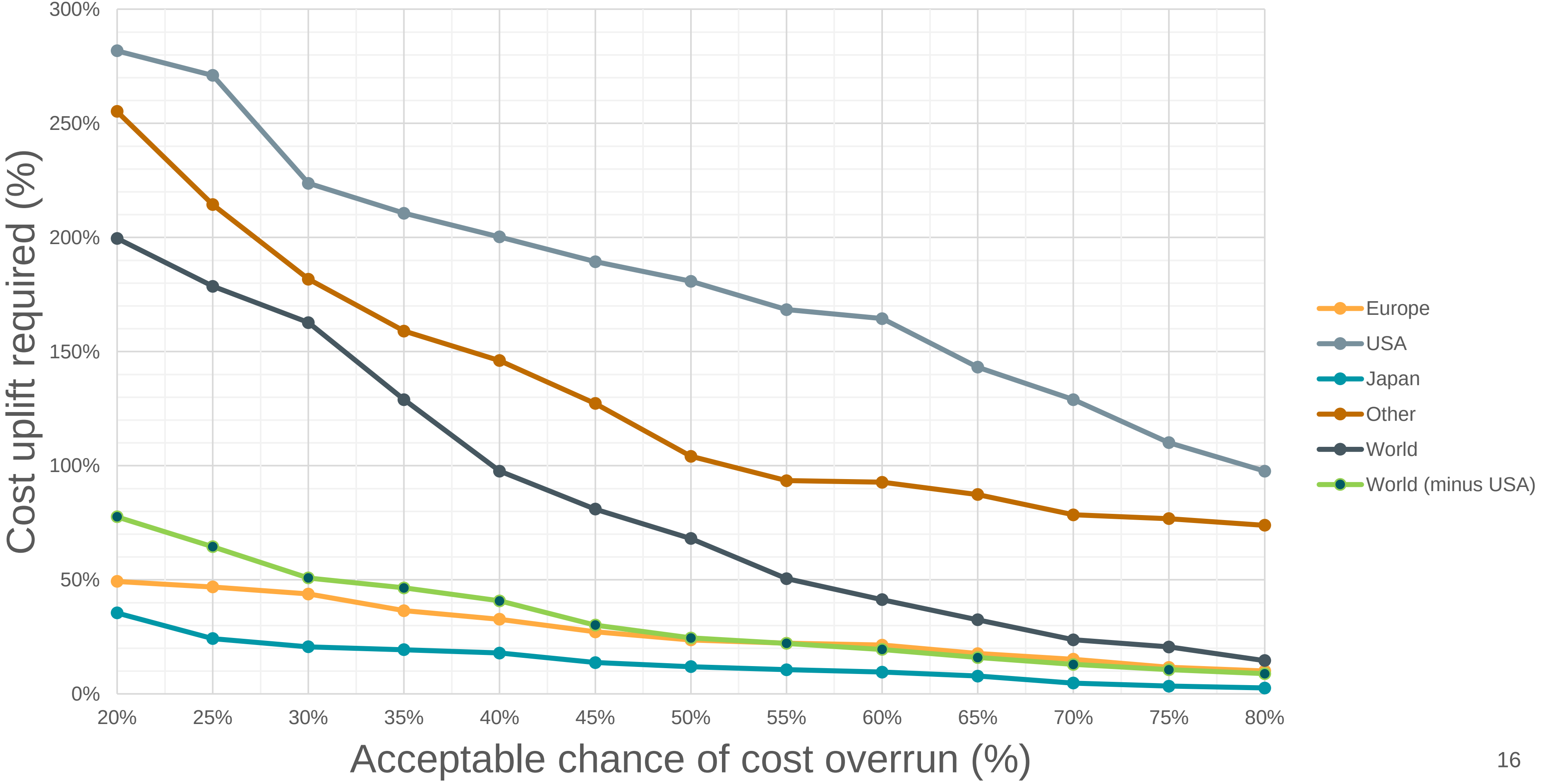


Preliminary RCFs.

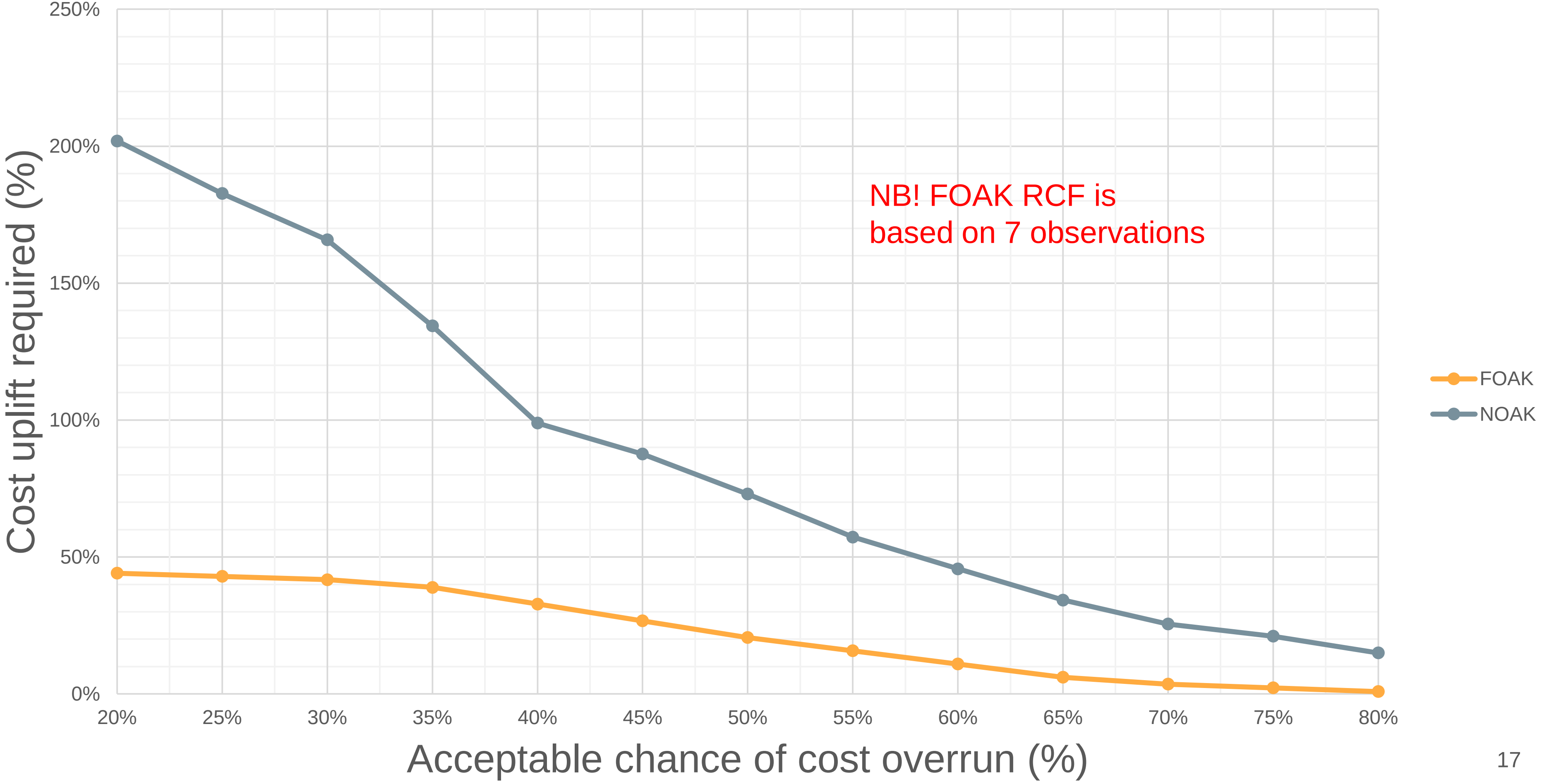
Cost reference classes by reactor type



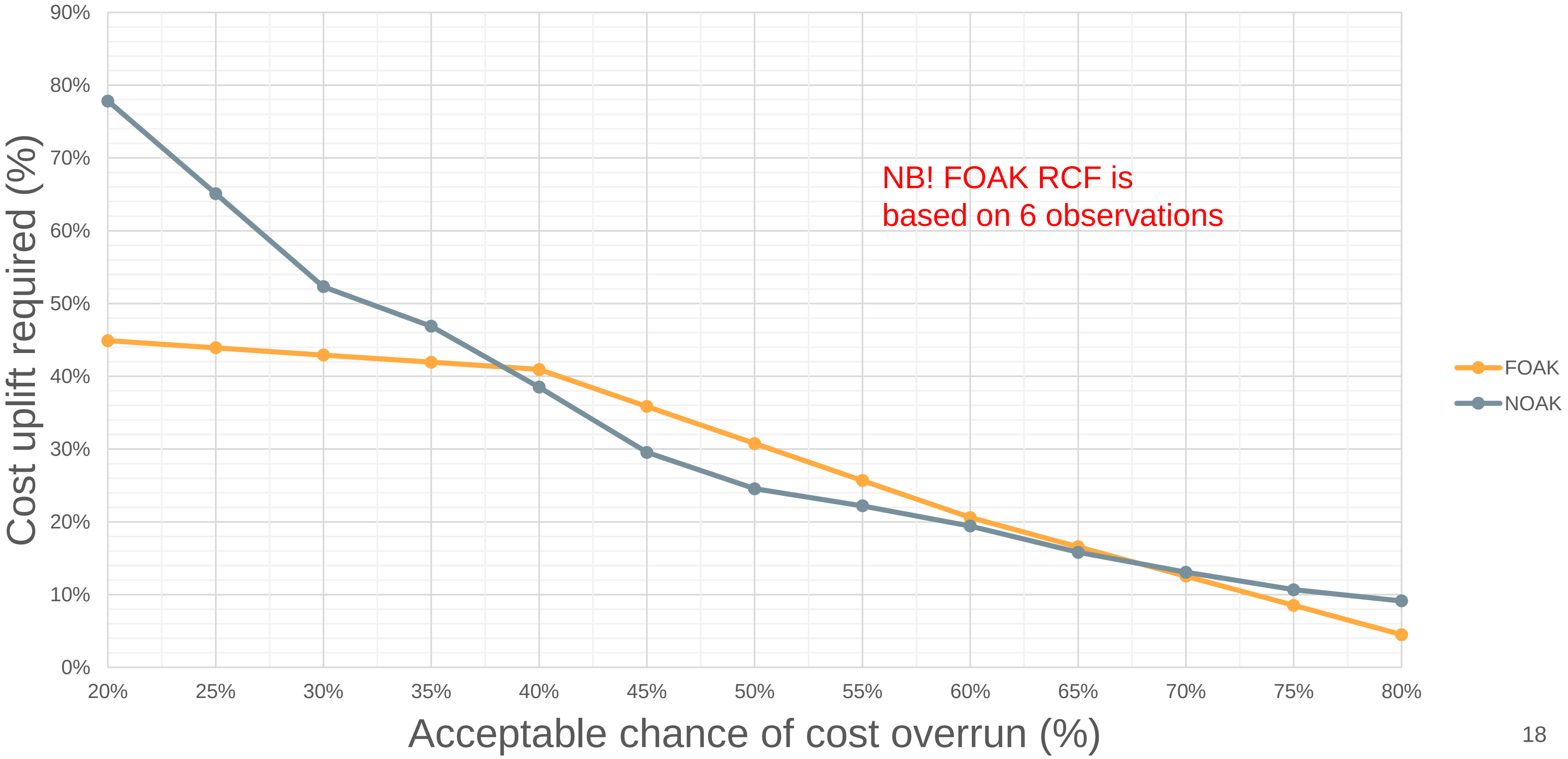
Cost reference classes by geography



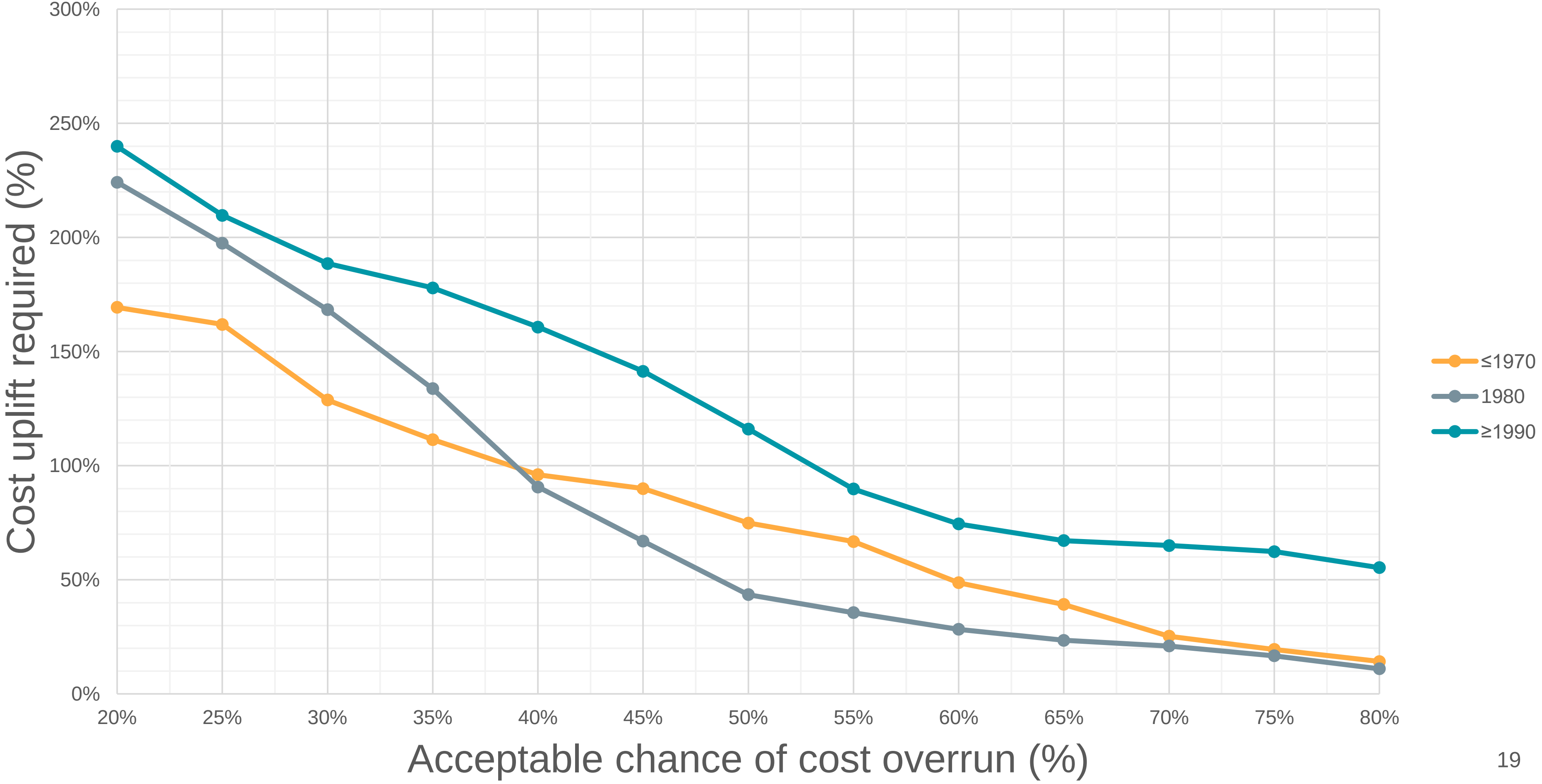
Cost reference classes by FOAK/NOAK categorisation



Cost reference classes by FOAK/NOAK categorisation
(minus US projects)

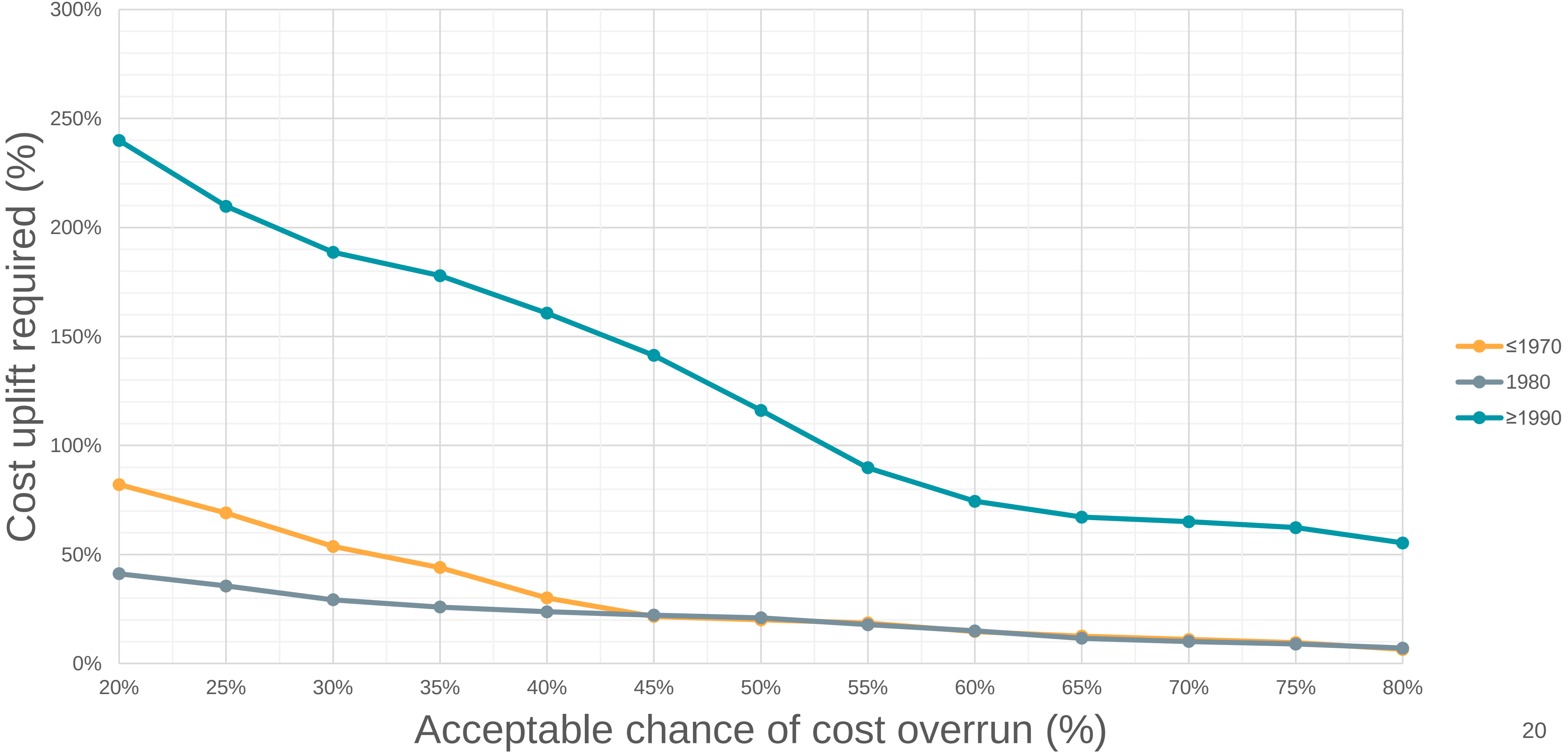


Cost reference classes by opening decade

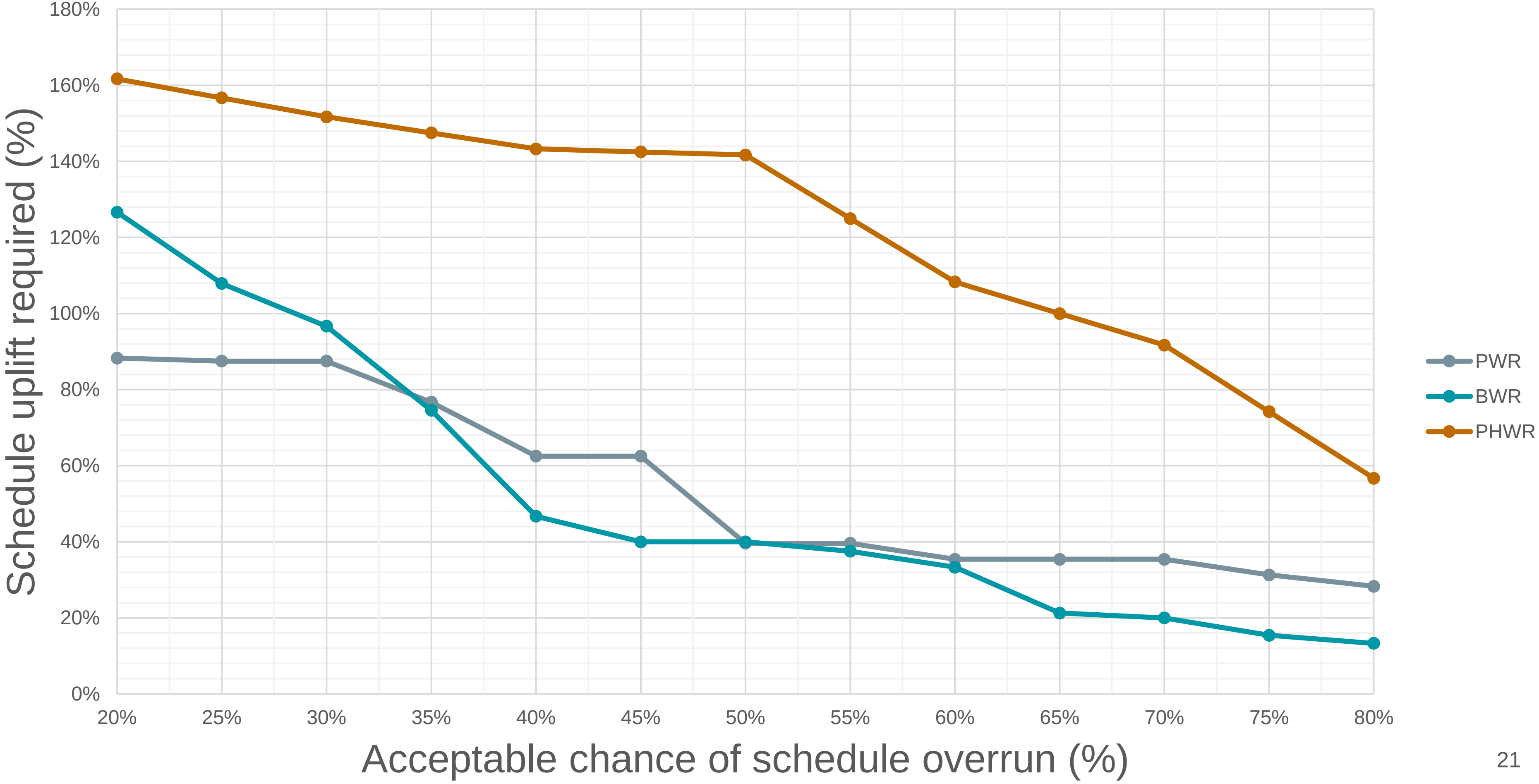


Cost reference classes by opening decade

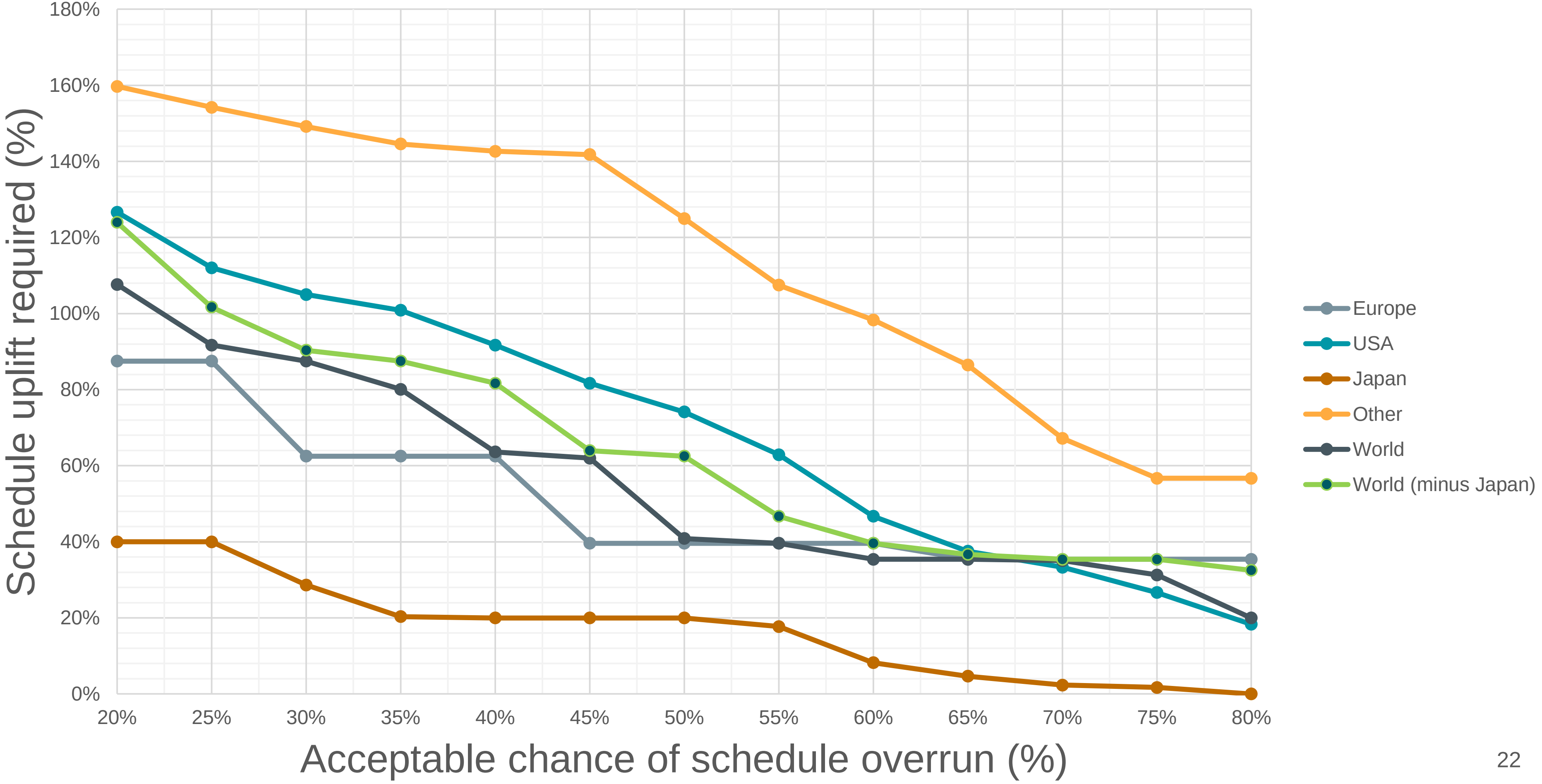
(minus US projects)



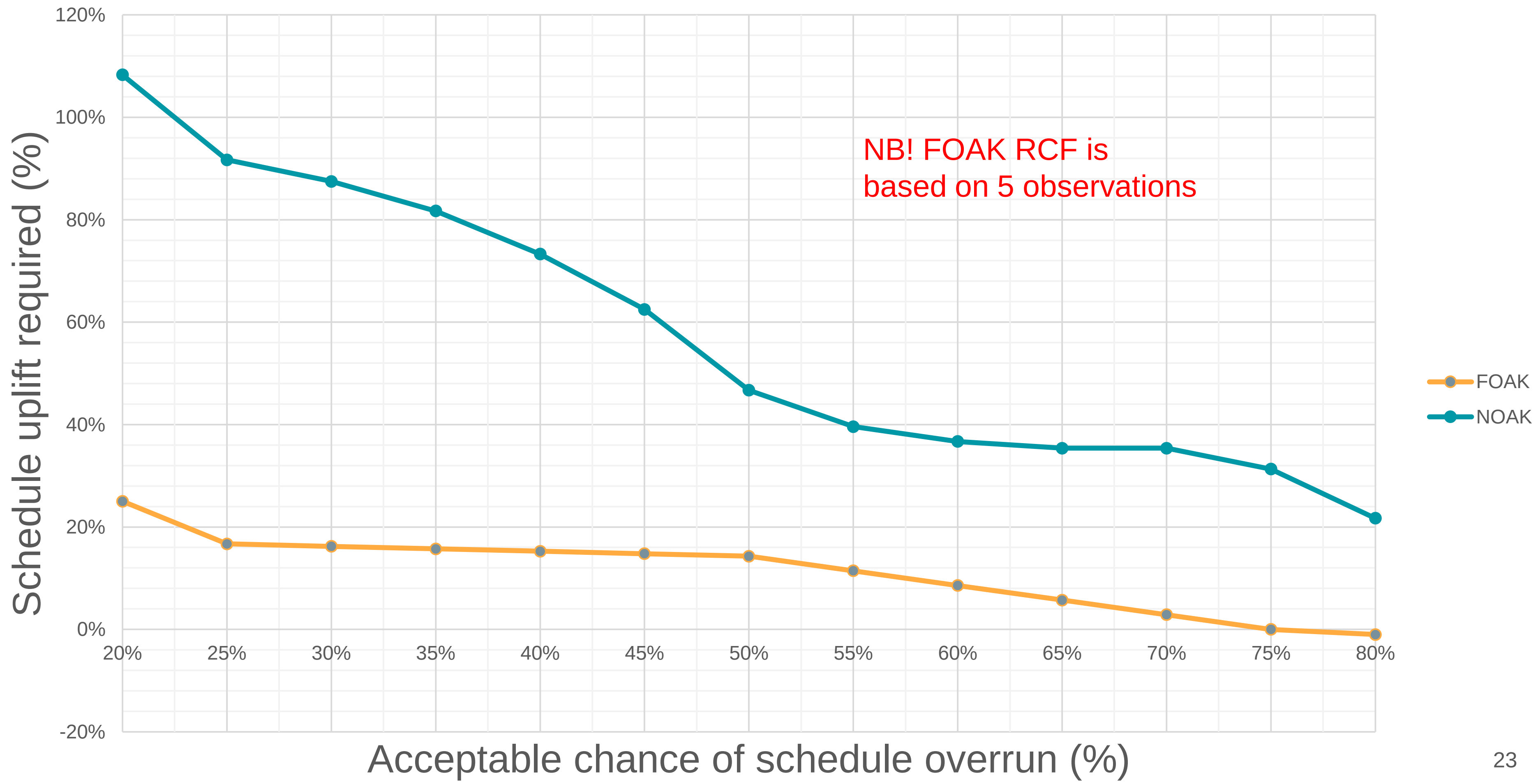
Schedule reference classes by reactor type



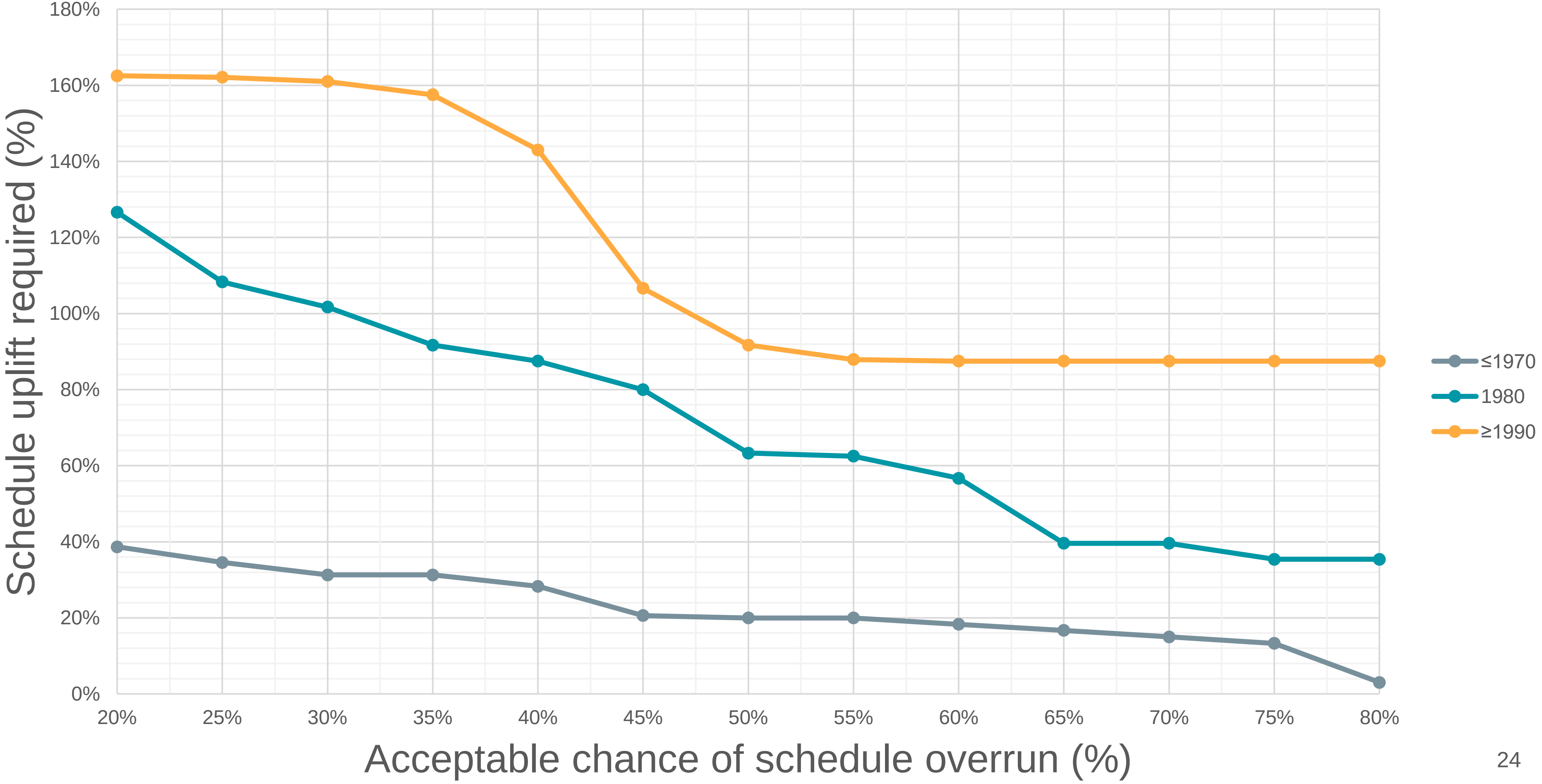
Schedule reference classes by geography



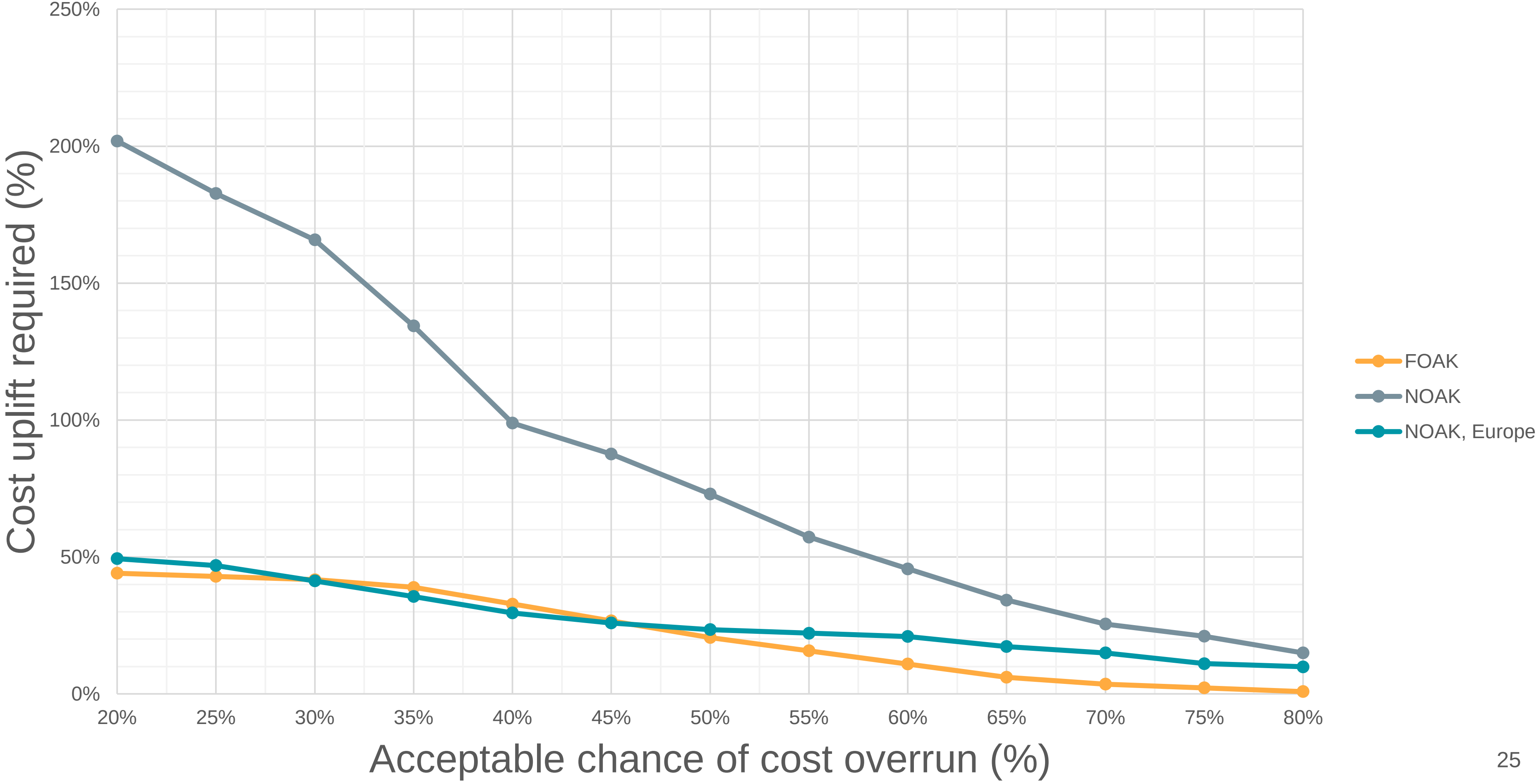
Schedule reference classes by FOAK/NOAK cat.

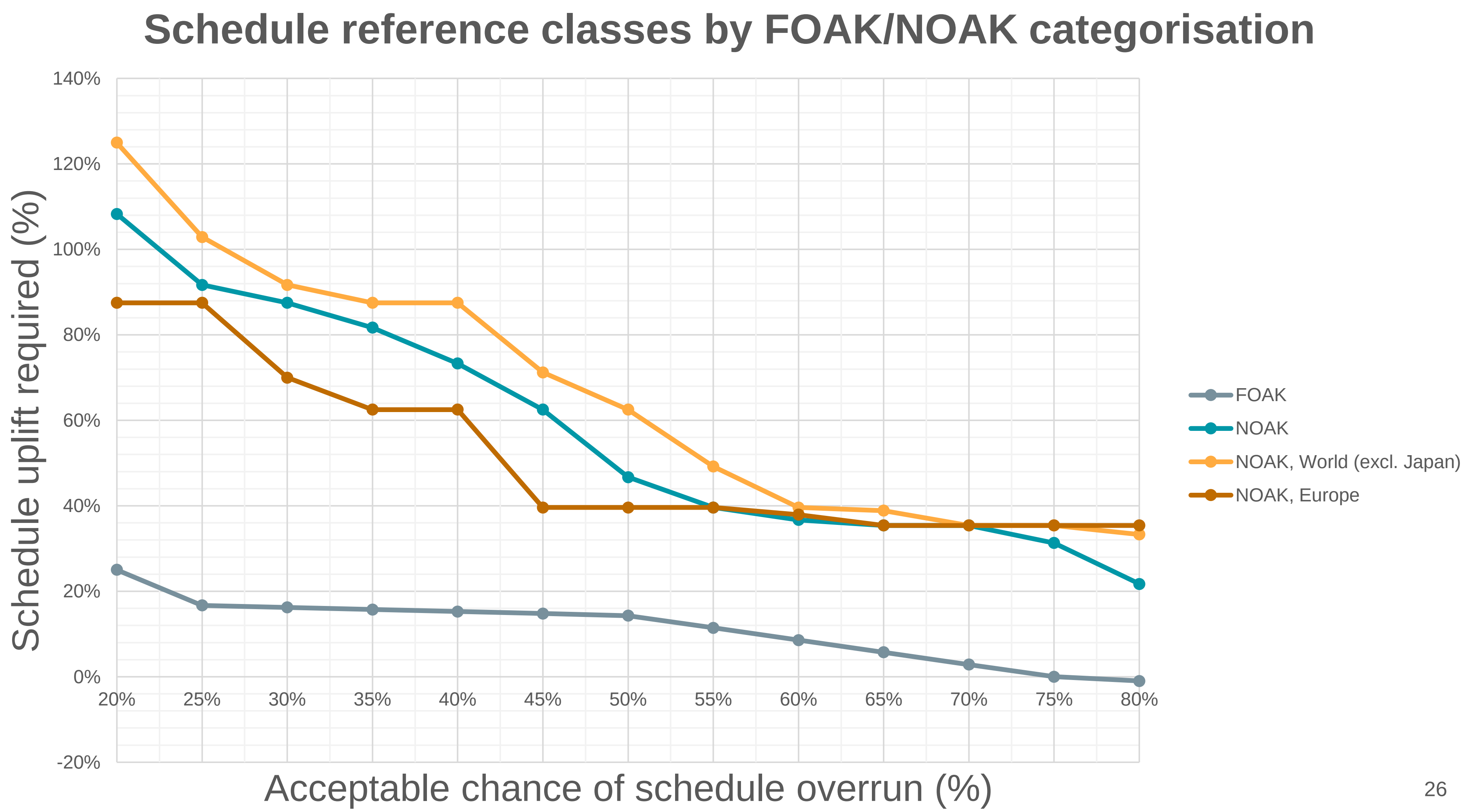


Schedule reference classes by opening decade



Cost reference classes by FOAK/NOAK categorisation




Schedule reference classes by FOAK/NOAK categorisation
Schedule uplift required (%)
140%
120%
100%
80%
60%
40%
20%
0%
-20%
20%
25%
30%
35%
40%
45%
50%
55%
60%
65%
70%
75%
80%
Acceptable chance of schedule overrun (%)
FOAK
NOAK
NOAK, World (excl. Japan)
NOAK, Europe