

Nazarbayev University Kazakhstan
Energy Transitions:
Exploring the nexus of Sustainability, Economy and Climate

Strategic Decision-making in Energy Policy

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Overview:

- ❖ **Private & Public decision scope**
- ❖ **Decision context and object**
- ❖ **Attributes framing decisions**
- ❖ **Context complexity & Cost-Benefit analysis**
- ❖ **Applied decision-making**
- ❖ **Annex**

Private Money Interests with & against Public Interests (use correct language)

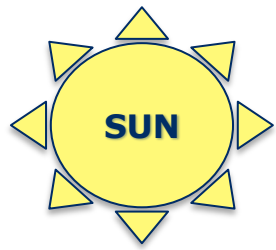
	Private money \$	Public values monetized in money \$	Societal = Private + Public
Debet	(1) Expenses	Negative external effects bv. pollution, degradation extinction, morbidity, mortality, ...	(1) Costs
Credit	(2) Revenues	Positive external effects Public goods & services	(2) Benefits
	(2) - (1) + = Profit - = Loss		(2) - (1) + = Welfare higher - = Welfare lower

Making decisions

- **Always for the Future**
 - **Horizon: near term, long term, very long term, infinity ∞**
 - **Incertitude in degrees: risk, uncertainty, ignorance**
- **A decision is a definite commitment (mostly of economic resources)**
 - **Revoking cost of a decision may be low, medium, high, extreme**
 - **Group decisions: selection via voting rules, or mandated board, person**
 - **Transparency and accountability!**
 - ***Procedural ethics*: involve affected people via information, participation**
- **Intuitive and Formal Science based methods**
 - **In economic-financial context: Discounted Cash Flow analysis**
 - **Mixture of methods depending on problem size**
 - **Prior decision: select the proper decision approach**

Decision CONTEXT & OBJECT

Determining FACTORS in the **CONTEXT** of Energy & Climate



IDEAS
Myths
Symbols
Images
Language
Narratives
Discourses
Ideology
Paradigms
...
INFLUENCE
LEGITIMACY

INSTITUTIONS
Habits
Norms
Rules
Laws
Institutes
...
POLITY

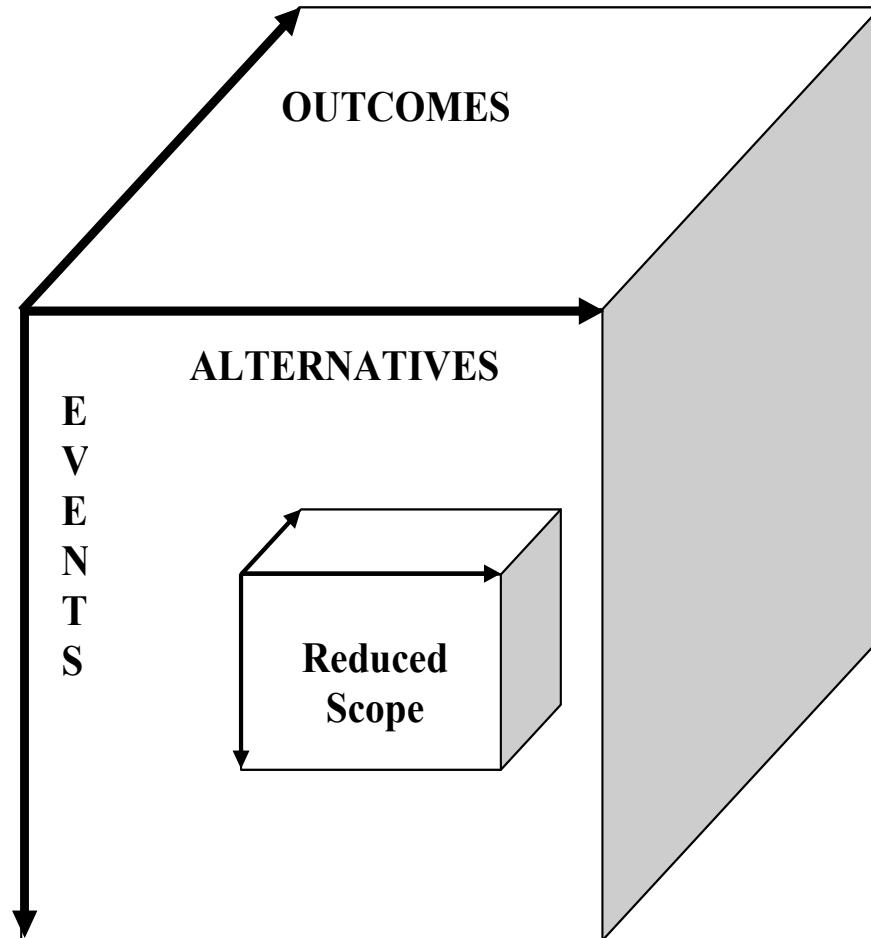


INTERESTS
Positions
Power
Knowledge
Property
Capital
Income
...
MONEY

INFRASTRUCTURES
Buildings
Transport
Production
Commerce
Recreation
...
ASSETS

SUBSTRATE
Energy & Technology
...
TRANSFORMATIONS

Decision Objects are characterized by 3 components



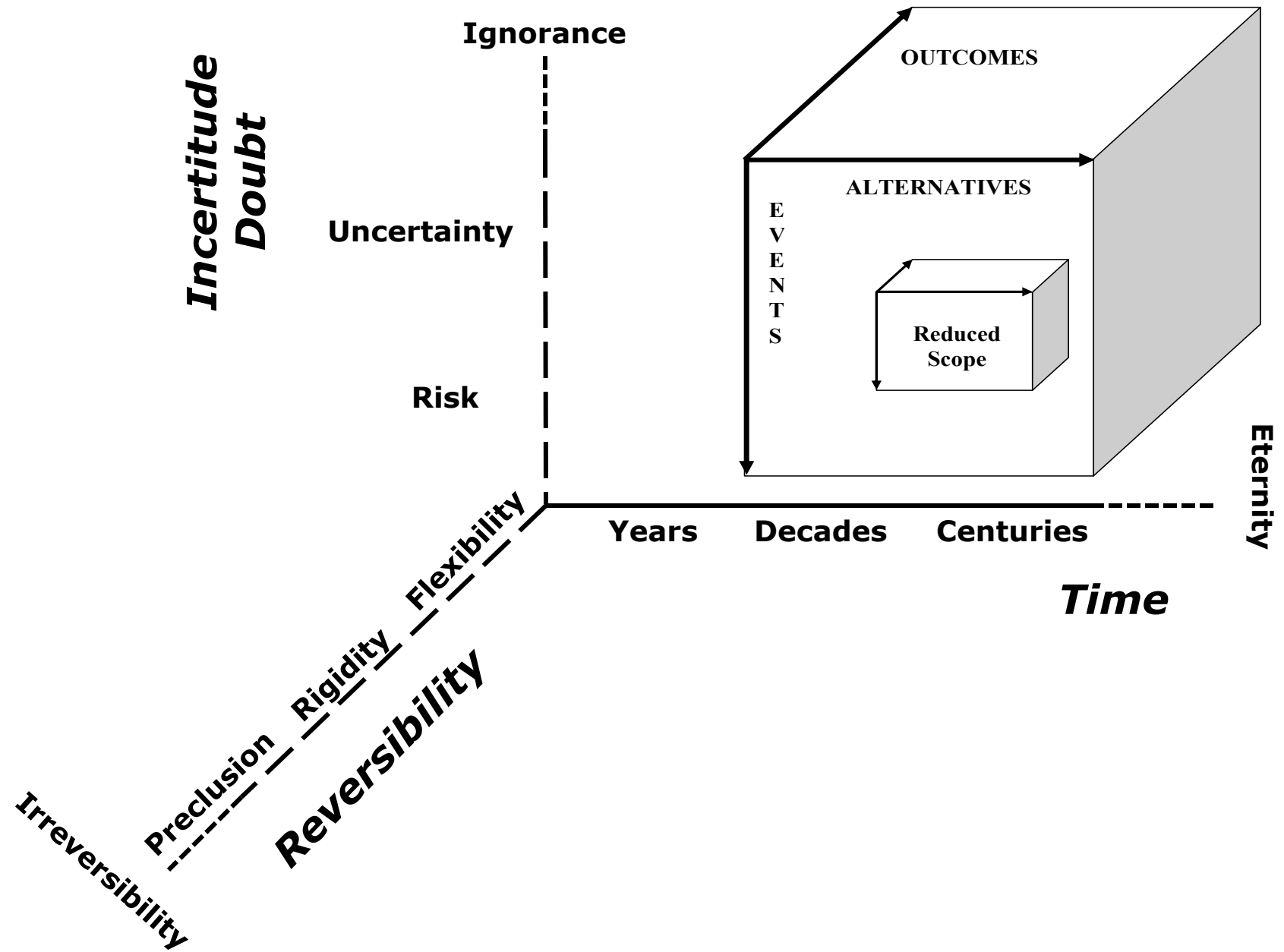
EVENTS
(beyond your power)

ALTERNATIVES
(what you can do)

OUTCOMES
(what matters)

A good analysis is
* comprehensive
* complete
* consistent

Three attributes frame decisions

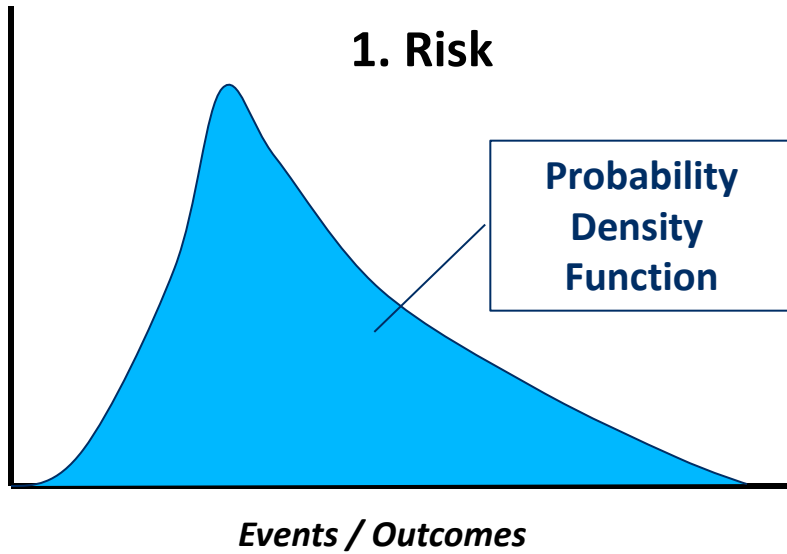


Attribute TIME: how long lasts the decision & its +/- outcomes

- **Time preference: 'Money now' more valuable than 'money later'**
- **Time processing by *discounting* net cash flows of future years, with two decisive parameters:**
 - **the length of time horizon N**
 - **The selected discount rate i**
- **Indicators of financial performance**
 - **NPV (Net Present value)**
 - **IRR (Internal Rate of Return)**
 - **Annuities**
 - **LCOE = Levelized cost-price of energy / electricity**

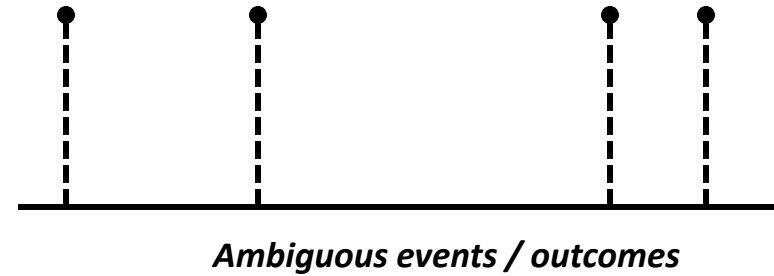
Attribute Incertitude, Doubt refers to 3 levels

Probability



2. Uncertainty

Unknown Probabilities

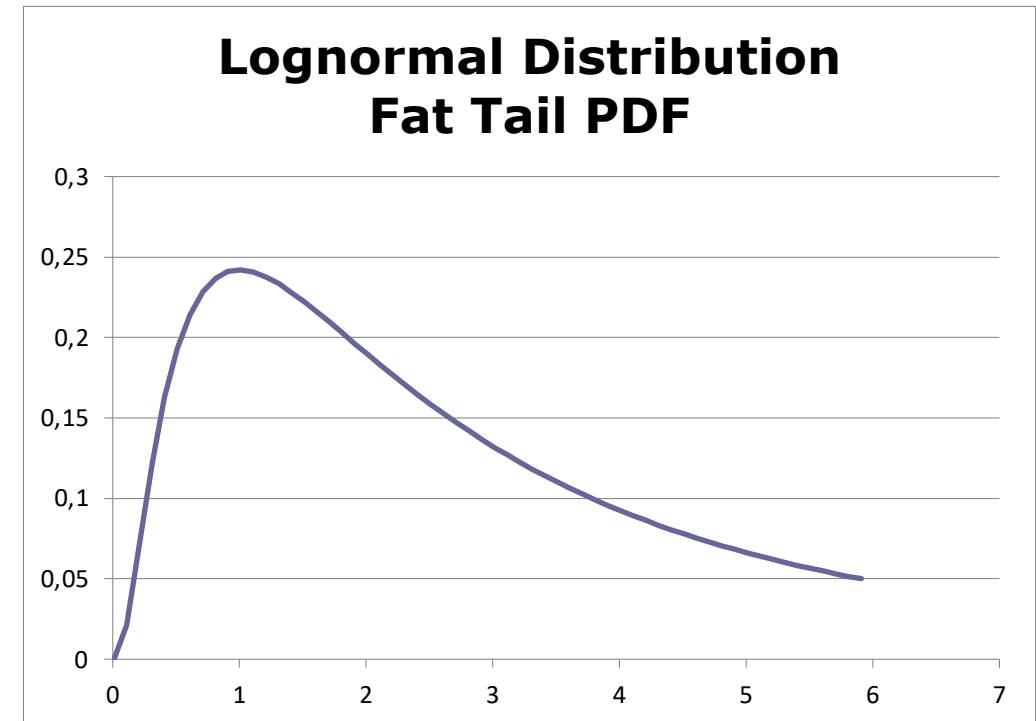
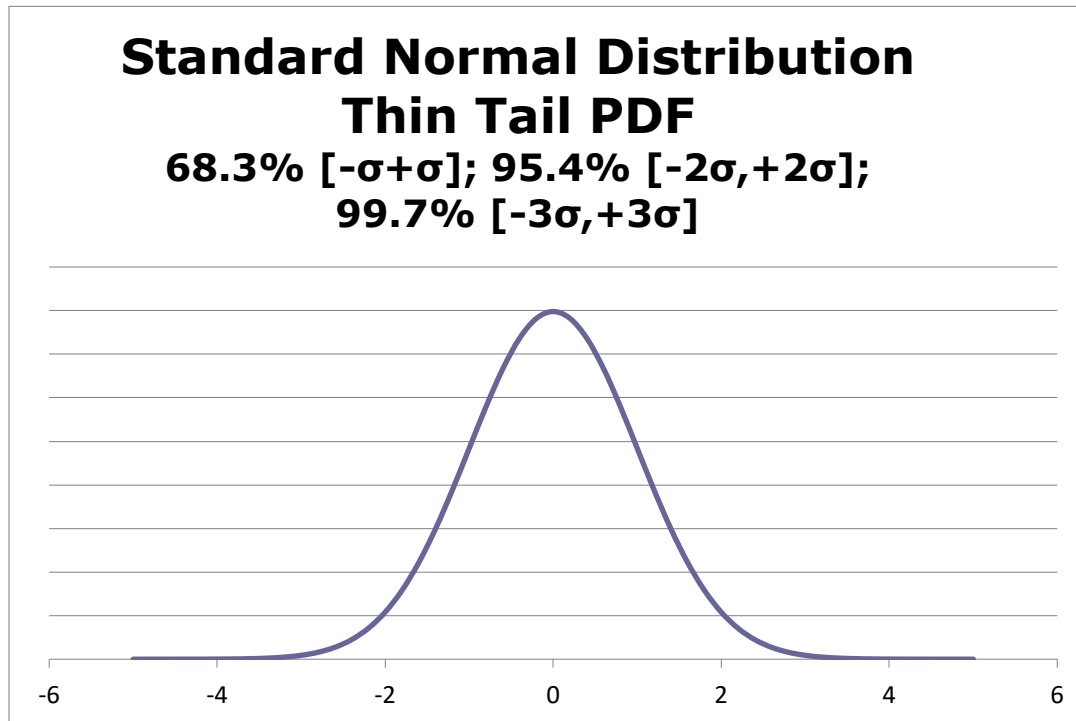


3. Ignorance

Known Unknowns
Unknown Unknowns



Probability Density Functions (PDF)



Cost-Benefit Analysis truncating PDF means exclusion of extreme events

Weitzman (2009) developed *Fat-Tailed Logic* including

- **PDFs with non-negligible tail probabilities (for example, the lognormal PDF)**
- **A cubic function expresses disutility & damage of high temperatures**
- **A discount rate close to zero assigns more weight to the distant future**
- **Recognize elevated GHG stocks + inertia + *irreversible* impacts by climate change**

Attribute gradual reversibility, with absolute irreversibility as endpoint

Definition of reversibility

- In economics, no standard scientific definition exists
- Literal deductions 'possibility to return to a previous or initial state' trivialize the concept; 'return in time' is not feasible
- Remind: a subject, object, system, ... is characterized by *identity & functionality*

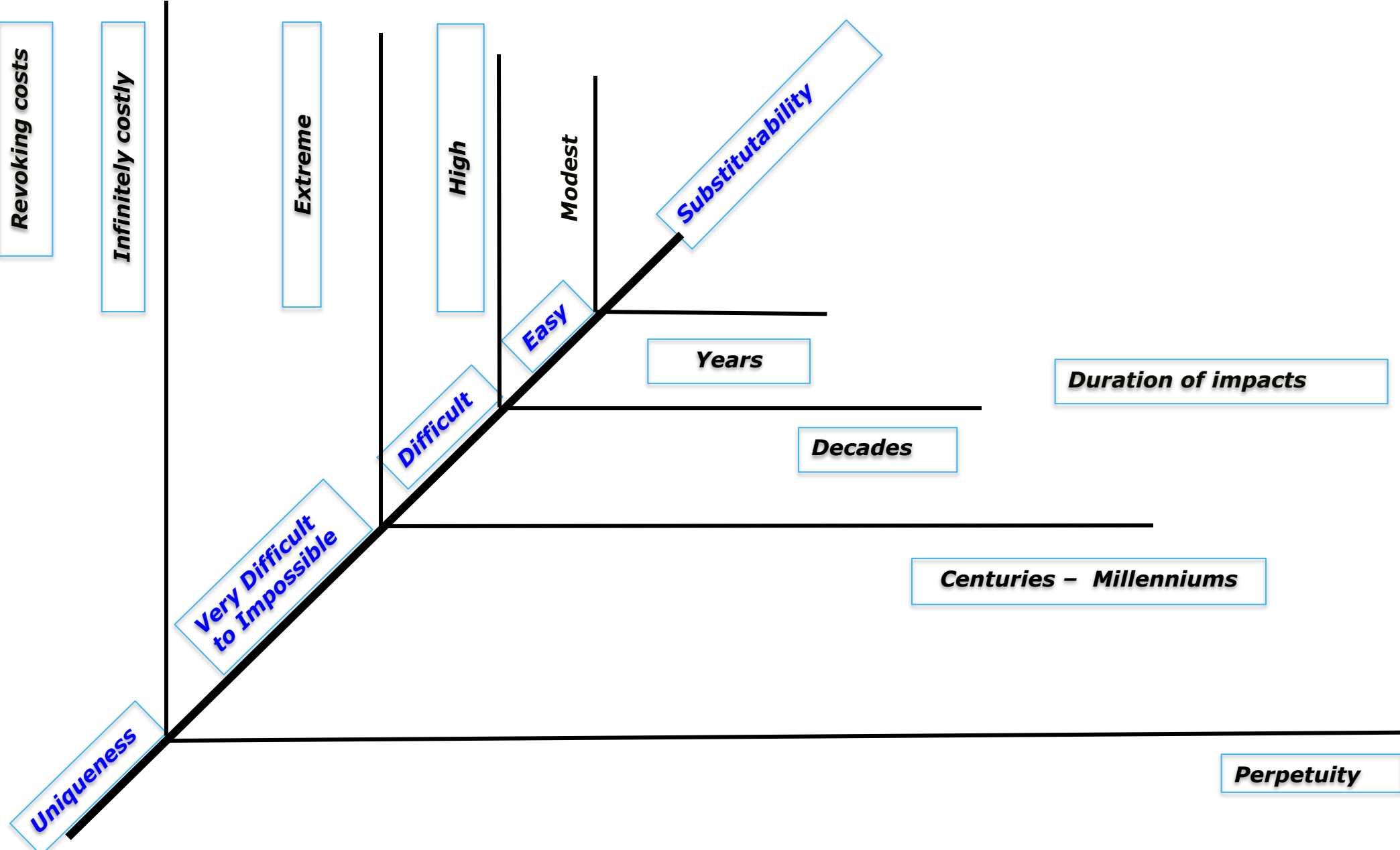
Definition

Reversibility is the ability to maintain and to restore the functional performance of a system
system = interconnected set of elements coherently organized in a way that achieves something
ability: qualified by 'at affordable costs within a reasonable time'
maintain and restore (≠ revert) ≈ resilience
functional performance ⇔ identity: a personal identity is also a functional unit of humankind

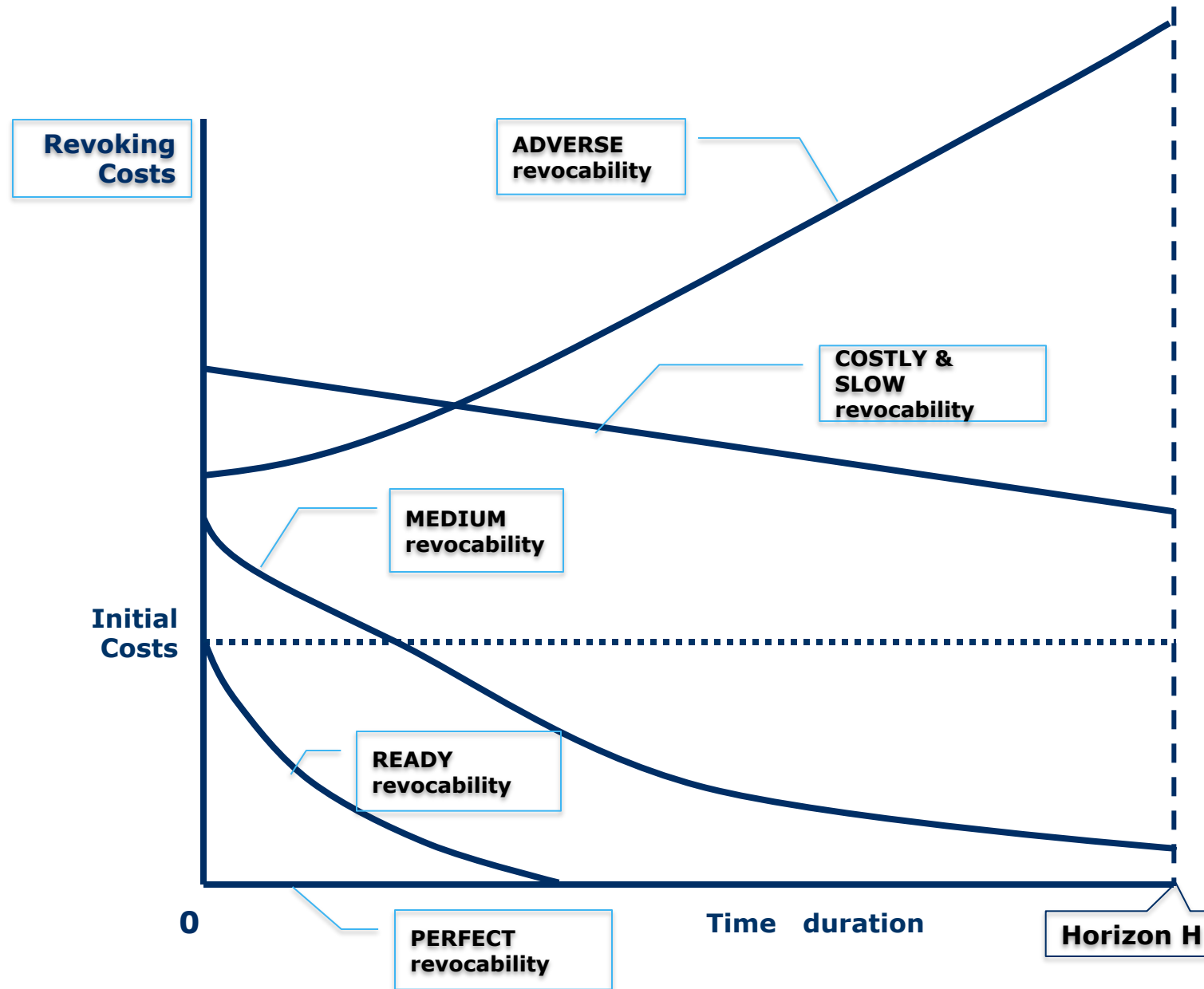
***A unique identity has no substitute.
When its functional performance breaks down, real irreversibility occurs.***

Example: the Earth's mild climate

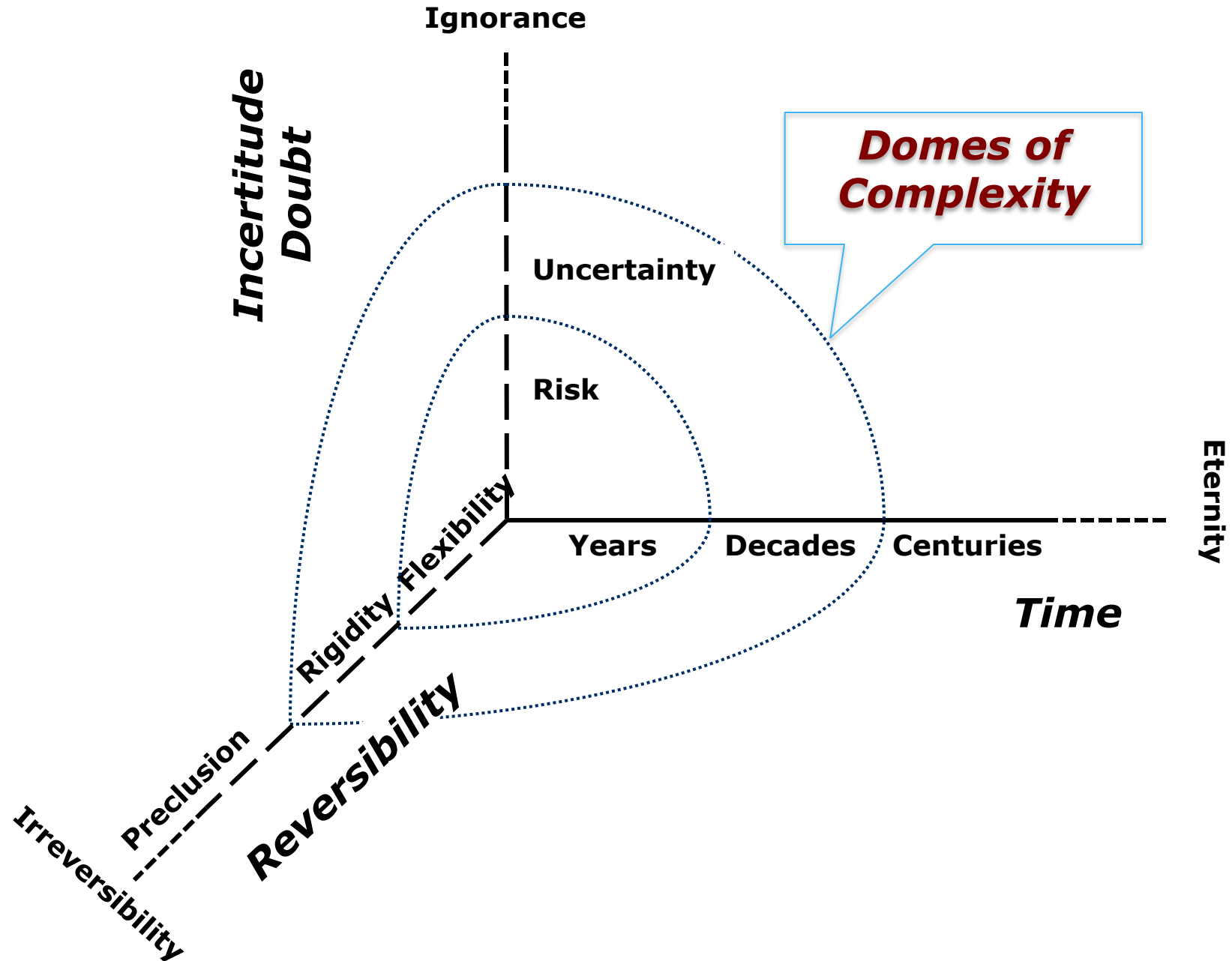
Reversibility space: substitutability, duration of impacts, revoking costs



Revocability (part of reversibility) depends on revoking costs



Context complexity



Context complexity and Cost-Benefit Analysis (CBA)

CBA is most applied in policy, yet only valid in non-complex context domes

- **Doubt limited to risk (+ some subjective probabilities)**
- **Reversibility in the flexibility range (+ some rigidity)**
- **Time horizon within an individual professional life-span (max. 50 years)**

Beyond the inner complexity dome, CBA becomes fuzzy
Beyond the second dome, CBA is counter-productive

Other decision mechanisms are needed, with e.g.

- **Foresight studies**
- **Democratic deliberation**
- **Multiple, diverse, revocable initiatives, enhancing resilience**

CBA studies are often manipulated, contentious, subject of stalemating

**For example: Stern Review (2006), heavily criticized by W. Nordhaus (Economics Nobel Prize, 2018)
because of applied discount rate (= weighing present vs. future)**

Applied decision-making

- **Risk Analysis by probability calculus**
- **Good decision = based on rational use of all information available
≠ **good outcome (partly decided by fortune)****
- **Analytical schemes**
 - **Static analysis**
 - **Filling the decision matrices**
 - **First hand and problems of limited scope and horizon**
 - **Dynamic, time-sequential analysis**
 - **Tedious, only for important, intricate decisions**
 - **'Wait and Learn' ⇔ 'Choose or Lose' situations**
- **Precautionary approach: humans accept limits and abstain from particular paths, choices, activities, ... due to**
 - **Ignorance is likely important**
 - **Time horizons beyond imagination**
 - **Irreversibility looming**

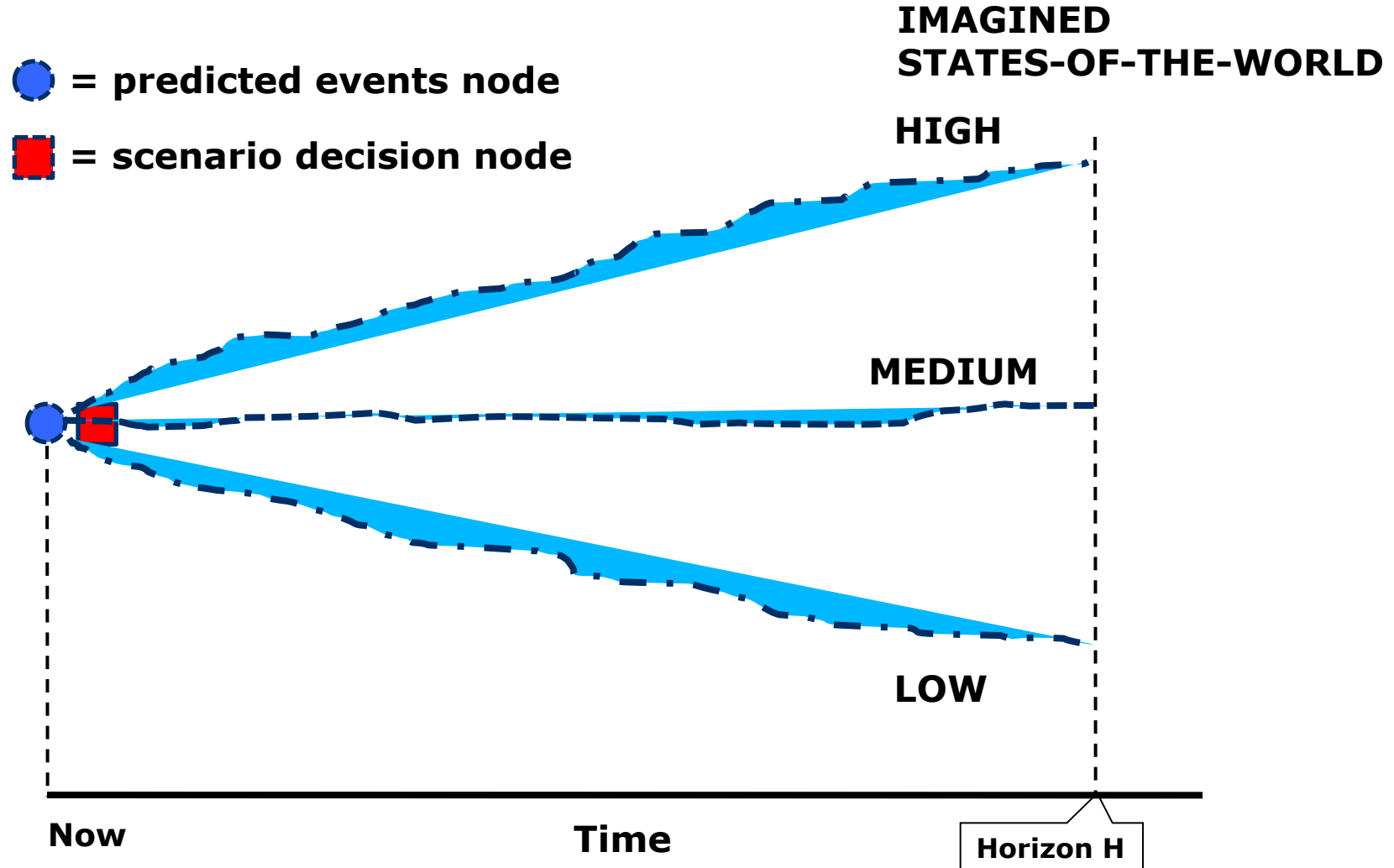
Static approach: (opportunity) loss tables

		<i>Alternatives</i>			
<i>Events</i>	Probabilities	<i>A1</i>	<i>A2</i>	...	<i>Am</i>
<i>G1</i>	P1	V1,1	V1,2	...	V1,m
<i>G2</i>	P2	V2,1	V2,2	...	V2,m
...
<i>Gk</i>	Pk	Vk,1	Vk,2	...	Vk,m
Criterion					
MiniMax	Minimum of	Max. {V _{i,1} }	Max. {V _{i,2} }	...	Max. {V _{i,m} }
Expected value	Minimum of	$\sum P_i \times V_{i,1}$	$\sum P_i \times V_{i,2}$		$\sum P_i \times V_{i,m}$

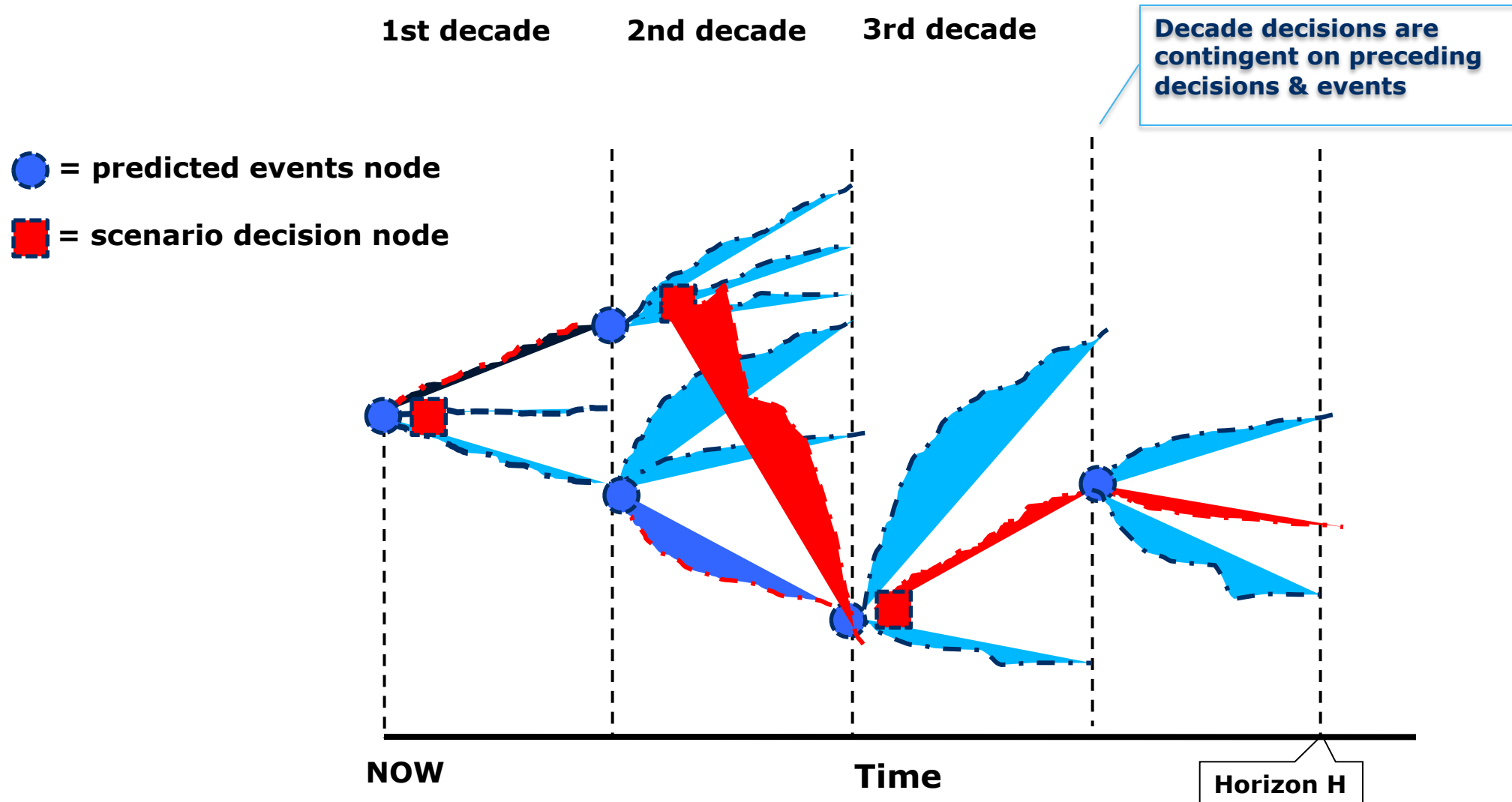
Legend

- **Not under control: k Events G_i with related Probabilities P_i**
- **Under control: m Alternatives (actions, strategies) A_j**
- **Outcomes of Event . Alternative combinations : k.m Values (+/-) $V_{i,j}$**
- **Decision criteria: MiniMax (of negative Values, e.g. # deaths); Expected Value**

Predicting the future by SCENARIOS



Exploring the future SEQUENTIALLY



Dynamic approach: case study data

Decision about the conversion of 100ha nature land in industrial area. In a two-period frame, one decides about the conversion shares in two phases S_1 , S_2 and $S_1 + S_2 \leq 1$. Conversion of nature to industry is poorly revocable, or S_1 stands through future phases.

DATA:

Assessed probabilities and outcomes for 100% conversion

Period 1 (now): decide on S_1 where $0 \leq S_1 \leq 1$

- **Convert 100%: + 100 M€ certain economic value in period 1**
- **Wait: 0 €**

Period 2 (future): decide on S_2 where $S_2 \leq 1 - S_1$

- **Positive value of 100% conversion: + 300 M€ with $P = 0.6$**
- **Negative value of 100% conversion: - 400 M€ with $P = 0.4$**

Dynamic approach: case study analysis

Standard approach:

- Calculate expected value in phase 2 of 100% conversion:
$$(0.6).(300 \text{ M€}) + (0.4).(-400 \text{ M€}) =$$
$$180 \text{ M€} - 160 \text{ M€} =$$
$$+20 \text{ M€}$$
- Add the 'certain' economic value of +100 M€ in phase 1
= total expected benefit +120 M€

RECOMMENDATION: convert 100% in first period

**HOWEVER: Is the standard scenario approach right?
NO! because available information is not properly used**

Dynamic approach: 'Wait & Learn' case

Phase 1 decision determines options open in period 2

Phase 2 reveals either the bad (-400 M€) or the good case (+300 M€) becomes real

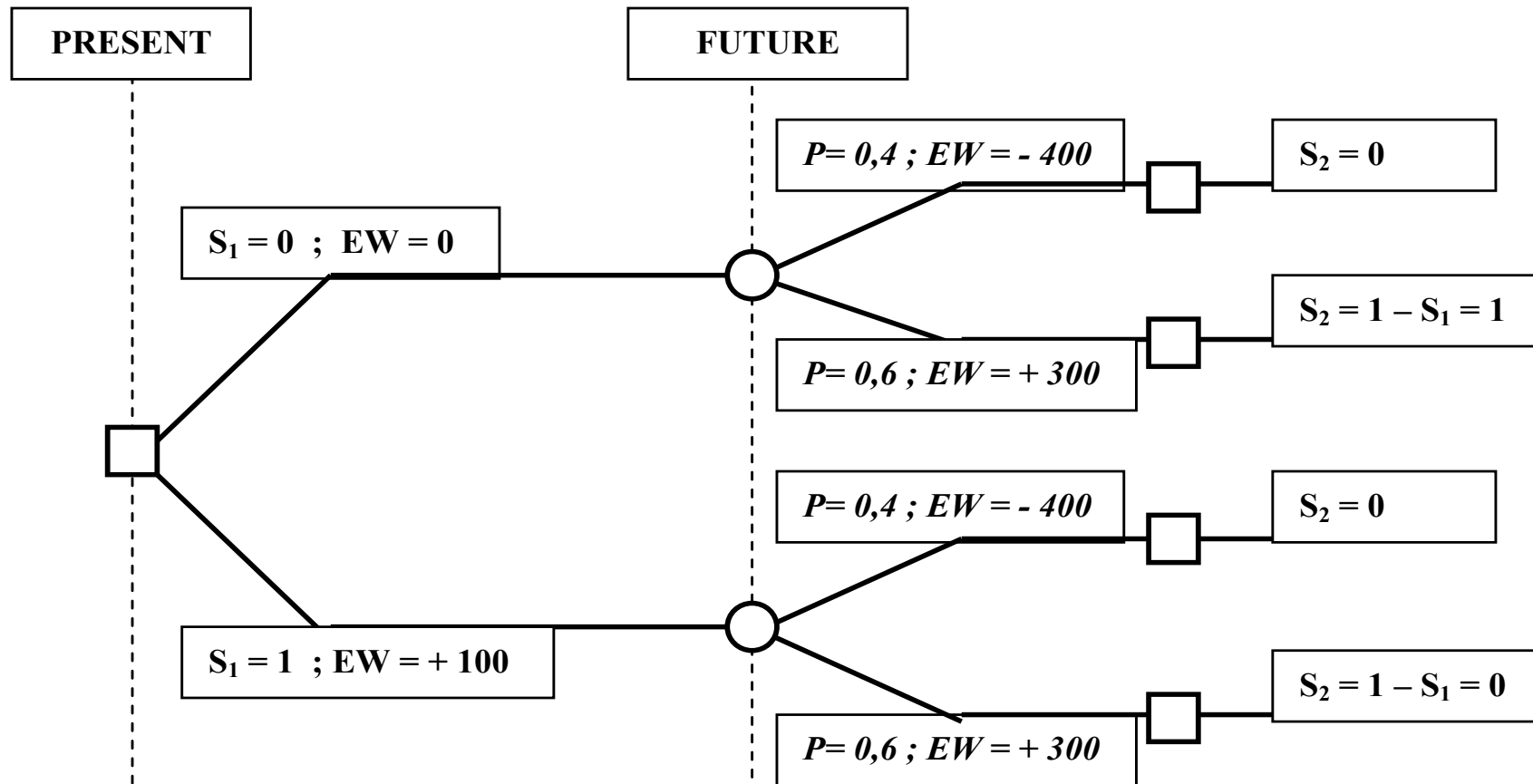
- In the bad case, S is as small as possible, however S_1 stands
- In the good case, S is maximized to 1, with $S_2 = 1 - S_1$.
- The benefit function to maximize:

$$\begin{aligned}
 & (+100 \text{ M€})\{S_1\} + (0.4).(-400 \text{ M€})\{S_1\} + (0.6).(300 \text{ M€})\{1\} \\
 & = [+100 \text{ M€} + (0.4).(-400 \text{ M€})]\{S_1\} + 180 \text{ M€} \\
 & = [-60 \text{ M€}]\{S_1\} + 180 \text{ M€}
 \end{aligned}$$

The benefit is maximum if $S_1 = 0$

**Conversion is postponed in period 1, to keep the choice option open for period 2
Uncertainty + Irrevocability are properly processed in this 'Wait & Learn' case**

Dynamic Approach: decision tree



□ = DECISION KNOT

○ = CHANCE KNOT

EW = Economic Worth
(present value)

Discount rate: decision variable

- **Rate is “accepted” value**
 - No firm theoretical basis to derive it
 - No central tendency with small deviation
 - No empirical consensus, but: 0 ... 5 ... 10 ... >20 %

- **Distinguish Public from Private decision-making**
 - Different issues, size, impacts
 - Decision contexts (time, doubt, irreversibility) differ
 - Wide >< narrow scope (equity, public values)
 - **Public rate <<< private rates**

- **Bridging gap from public plans (conceived at low rates) to private decisions (made with DCF studies at high rates),**
i.e., private agents do not execute the public plans,
i.e., incentives are necessary:
 - **Regulation**
 - **Instruments (social, economic, legal)**
 - **Taxes, subsidies**
 - **Enabling policies**

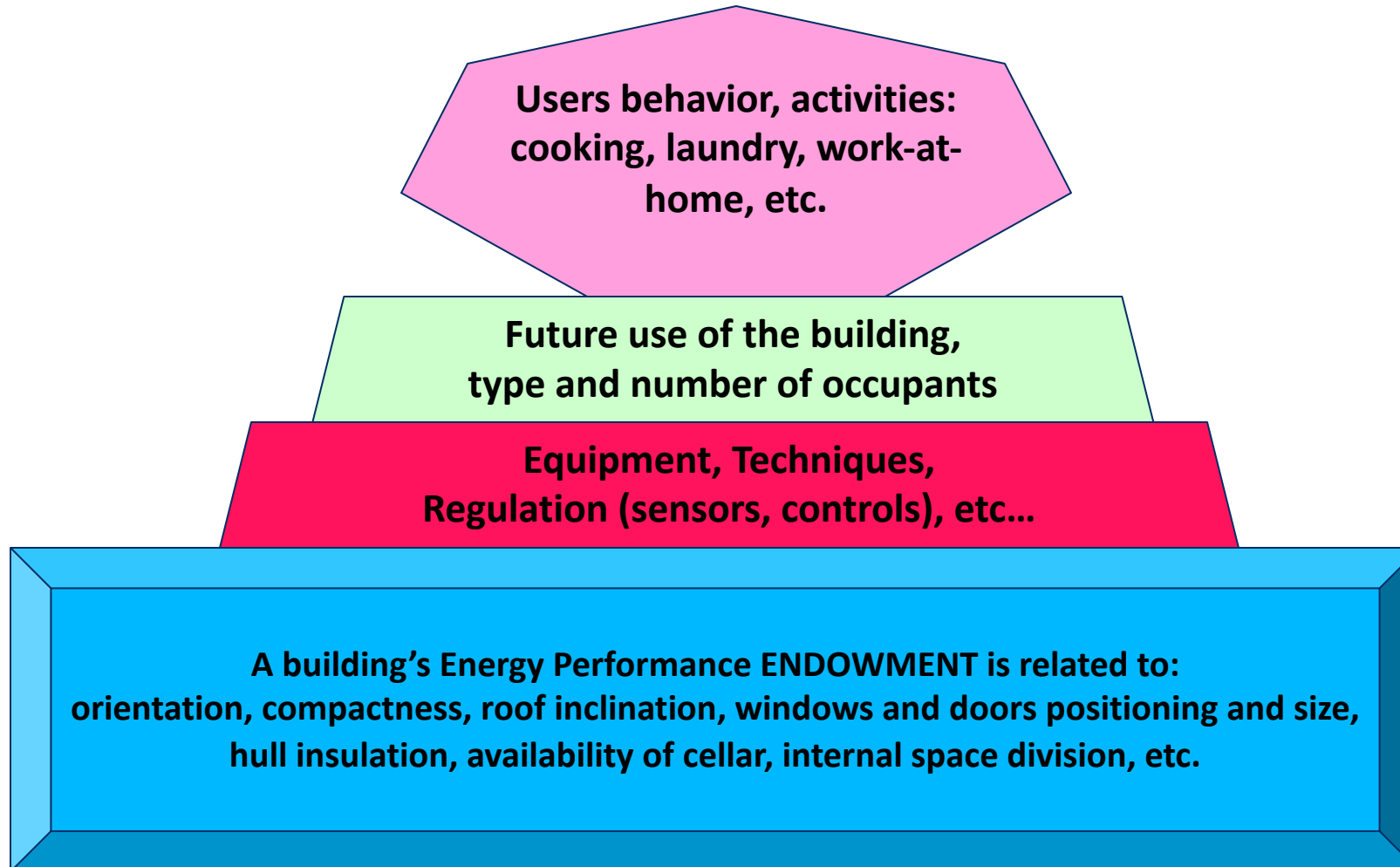
Fixing Discount rates

- **Private decisions**
 - **i expresses profitability threshold [see criterion $NPV(i) \geq 0$]**
 - **Marginal cost of capital is reference for i [leverage effect]**
 - **Tax regimes and particularities confuse fixing i**
 - **Adding risk premiums is common practice**

- **Public decisions**
 - **Diverging views: from 0% to private rates**
 - **0% because discounting = myopia/lack of imagination,**
 - **But at 0% and n running to ∞ , all outcomes are ∞**
 - **Private rates because of opportunity cost of capital**

 - **Unsolved issue when n is long and scope is wide**
 - **Low i values: public trading-off between present/future**
 - **No risk premium (state is risk neutral and final insurer)**
 - **The 'present' is a moving reality (e.g. decommissioning a nuclear facility in 2050 costing €1billion – weighed in 2020 ($N=30$, $i=5\%$) as €0,231bn – will need the €1billion (if not more) in 2050**

Factors influencing building energy use



Irrevocable Decisions 'Choose or Lose' Energy Performance Endowment of Buildings

Buildings Directive 2010/31/EU

Art.4 § 1: Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels

Art.2 § 14: cost-optimal = lowest cost during the estimated lifecycle

Art.5 : Announced framework for 'Calculation of cost-optimal levels of minimum energy performance requirements'

**'COST-OPTIMAL ENERGY PERFORMANCE' is CRUCIAL
But UNANSWERED by EU**

Deciding on building constructions

Constructing a building is a definite commitment of resources, implying irrevocability

- **Revocability of investment depends on revoking costs**
- **Distinguish Physical / Financial revocability**

A building investment:

- ❖ **Physical revocability is costly**
- ❖ **Financial revocable if liquid sales/renting markets exist**

Energy Performance Endowment (EPE) is not separable of physical construction, i.e. revocability is costly

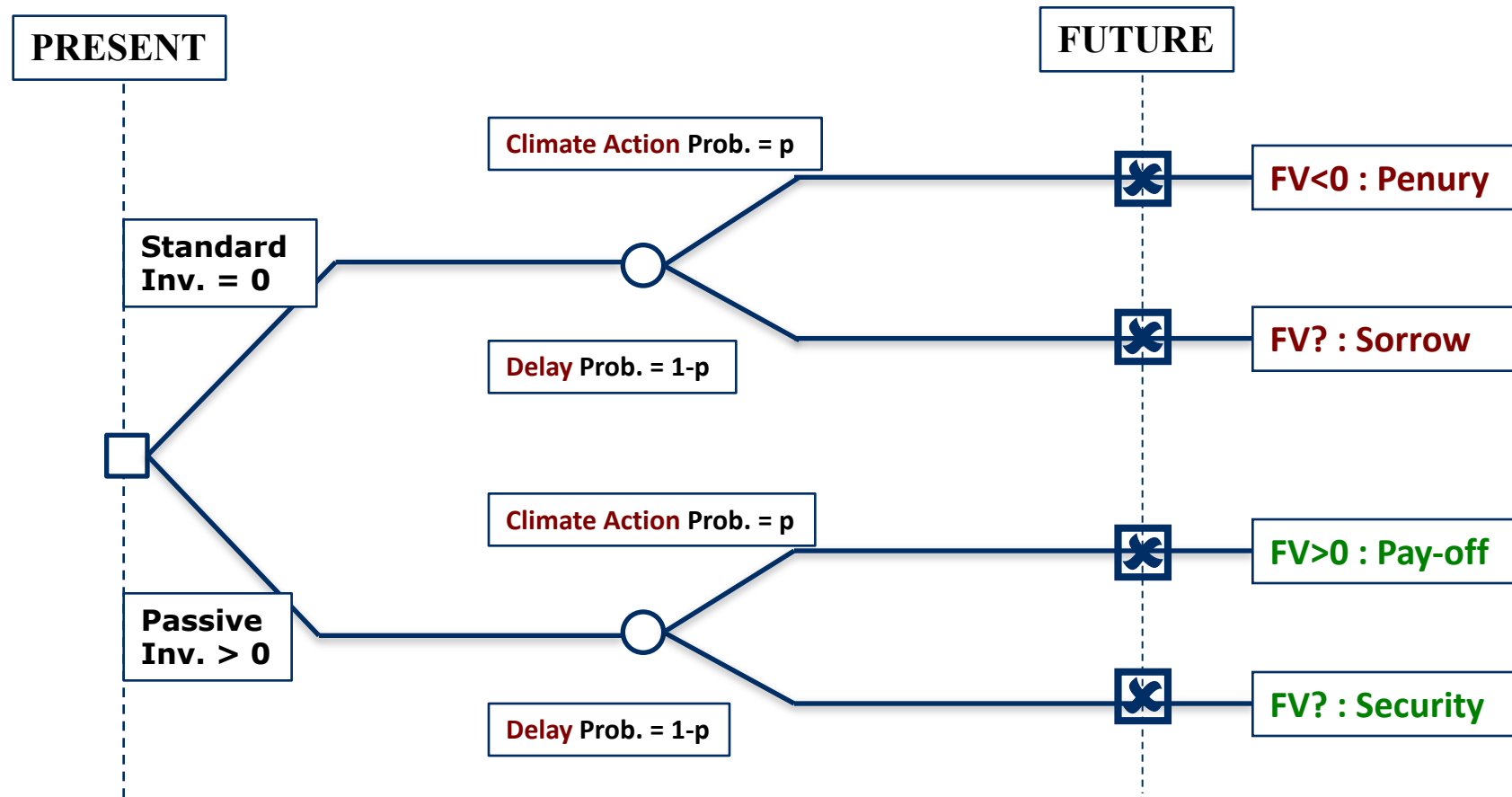
Many drivers trigger constructions' timing & features

Energy performance is a secondary driver, was weak but now gaining strength by climate change challenges

Sequential decision-making: CHOOSE or LOSE

Event example Climate Action versus Delay

- = decision node
X = precluded decision
 = event node
- Inv. = Investment in EPendowment (first period)
 FV = Future Value



Conclusion on Building Investment

- **Cost-optimal: crucial concept in Buildings Directive, but not developed – unclear**
- **Life-cycle appraisal: static, expected value method;**
 - **finds averages, not the optimal frontiers**
- **Energy Performance Endowment: revocability is costly**
 - ✓ **Appraisal requires right scientific methods**
- **Recommendations**
 - ✓ **Identify & weigh all benefits of sustainable buildings**
 - ✓ **Avoid preclusion of necessary future solutions**
 - ✓ **The good may be the worst enemy of the best**
 - ✓ **The efficient borderline is needed to avoid middle-of-the-river quagmires**
 - ✓ **Choose now the best efficient, highly passive designs or Lose**

Who wants to be a loser?