

Policies and incentives promoting sustainability – small facilities in Germany, Sweden and Finland

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Background

Push for renewables – push to conserve and restore biodiversity.

Increasing need for balancing power.

This presentation focuses on struggling facilities, the small ones, and policies & incentives affecting their exit.

Examples from Germany, Sweden and Finland.

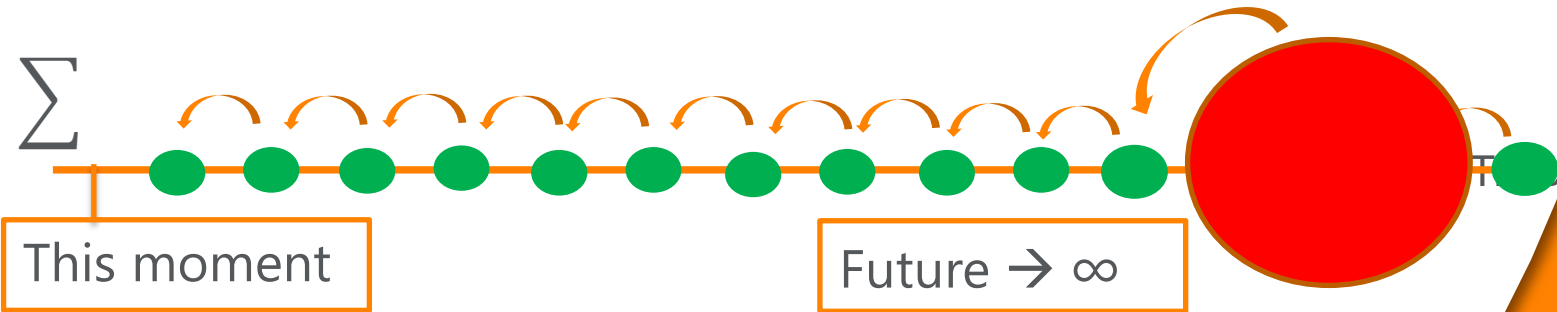
	Germany	Sweden	Finland
Total capacity	4 684 MW (+6 199 MW PHS) ¹	16 478 MW ¹	3 263 MW ¹
Number of facilities	~ 7 300 ²	~ 2 100 ³	~ 690 ⁴
Average capacity	0.64 MW	7.8 MW	4.7 MW
About the smallest facilities	6 900 < 1 MW; 6 000 < 0.1 MW ²	1 710 < 1.5 MW; 1 030 < 0.125 MW ³	466 < 0.1 MW

Before we go

One concept needs to be introduced.

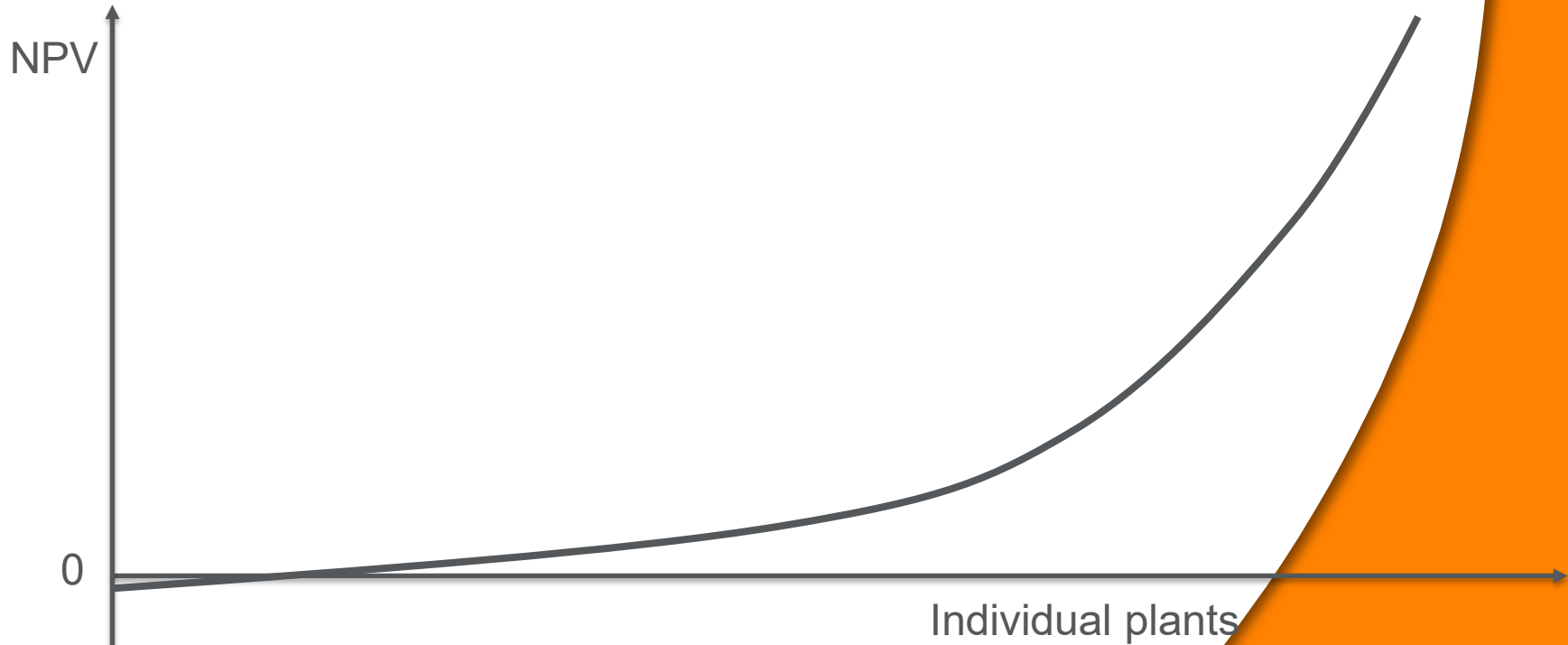
A Concept – Net present value (NPV)

Discount future revenues and costs to current time and sum them up \rightarrow NPV reflects the long term economic viability of an operation.

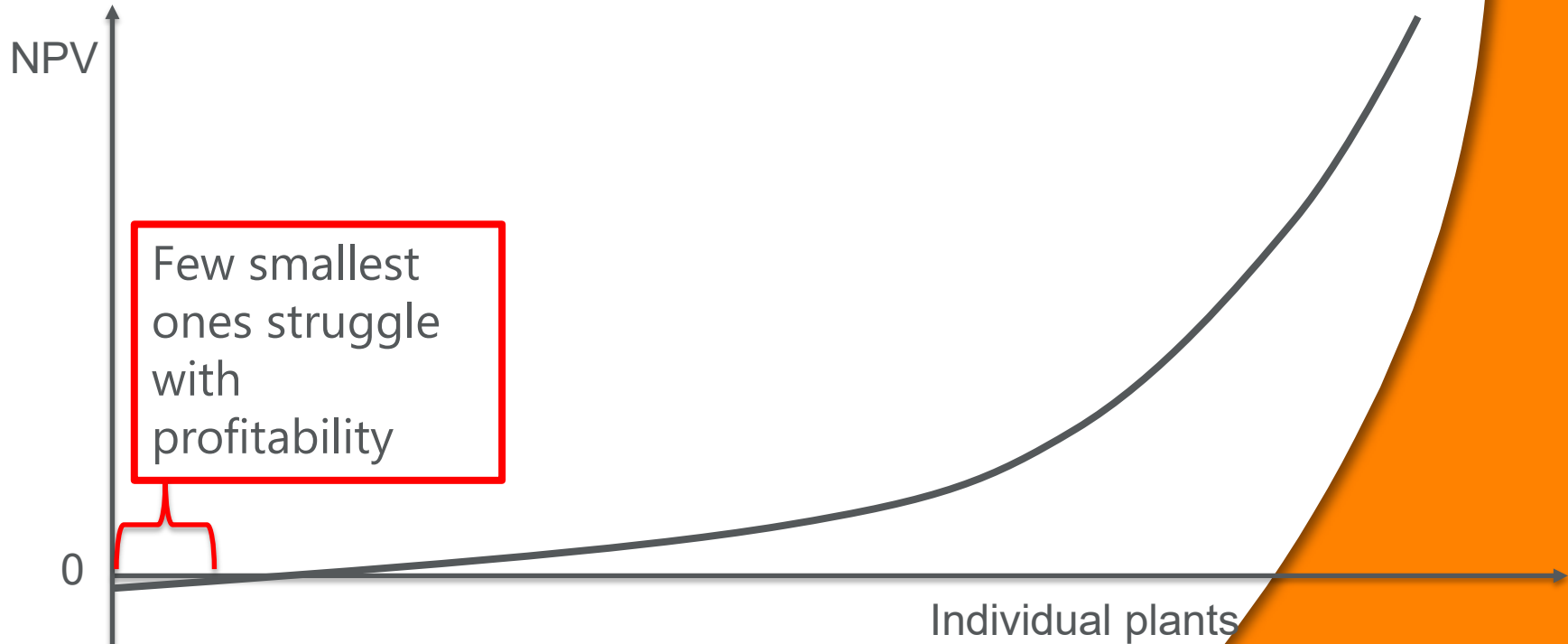


NPV used typically when assessing investments.
Can also be used for assessing existing activities.

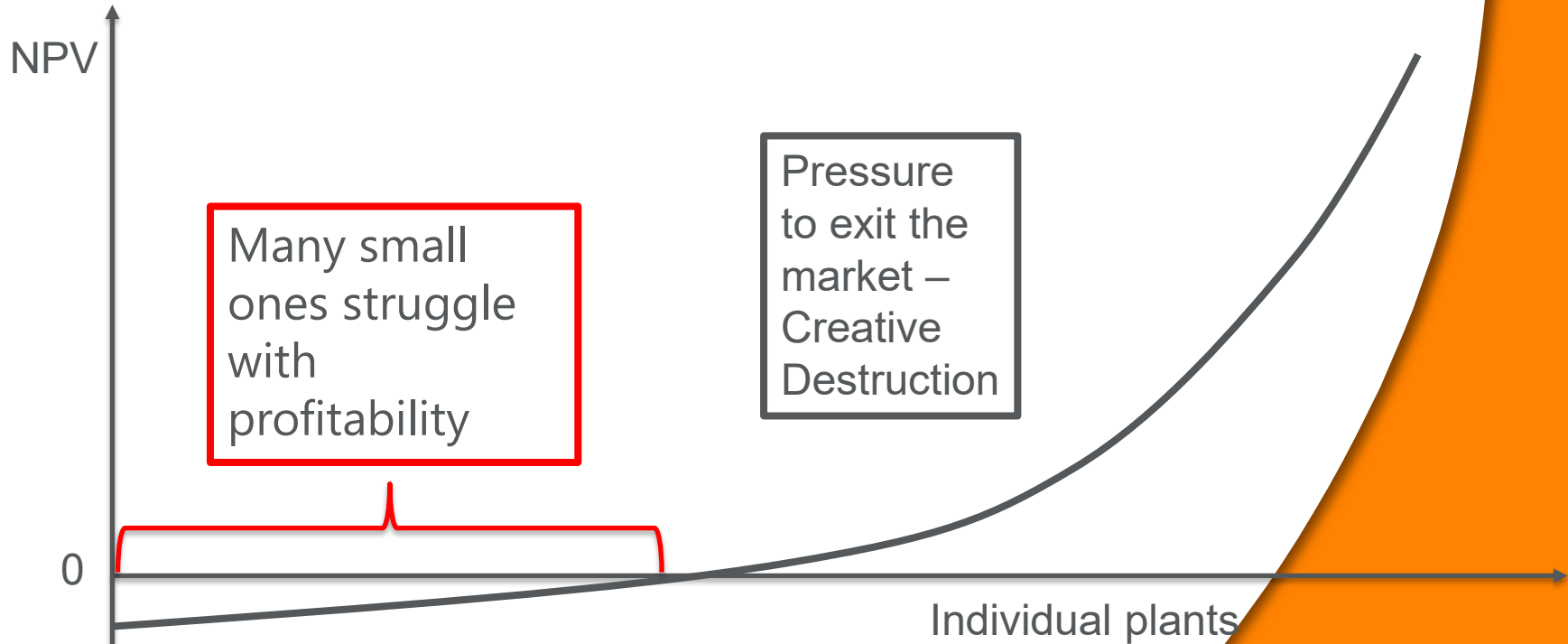
Stylized distribution of NPVs of a sector – hydropower or other



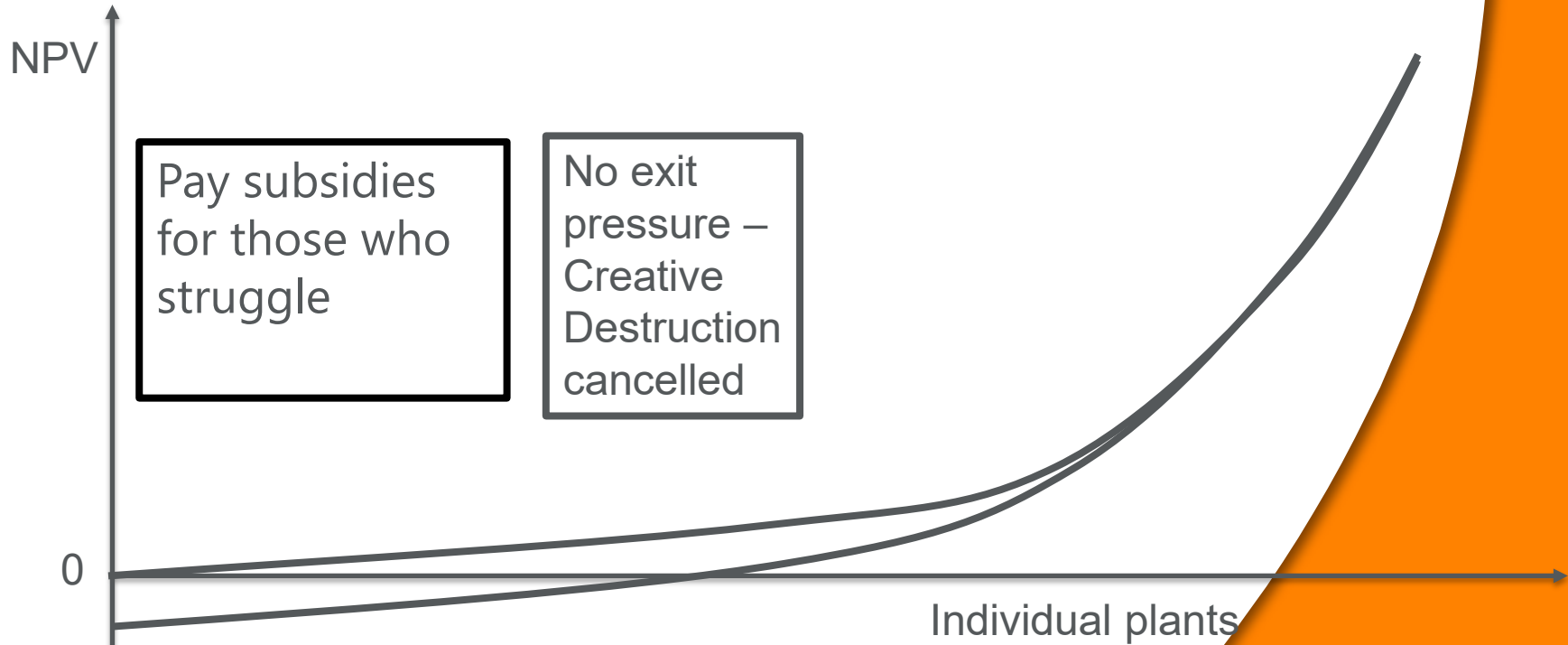
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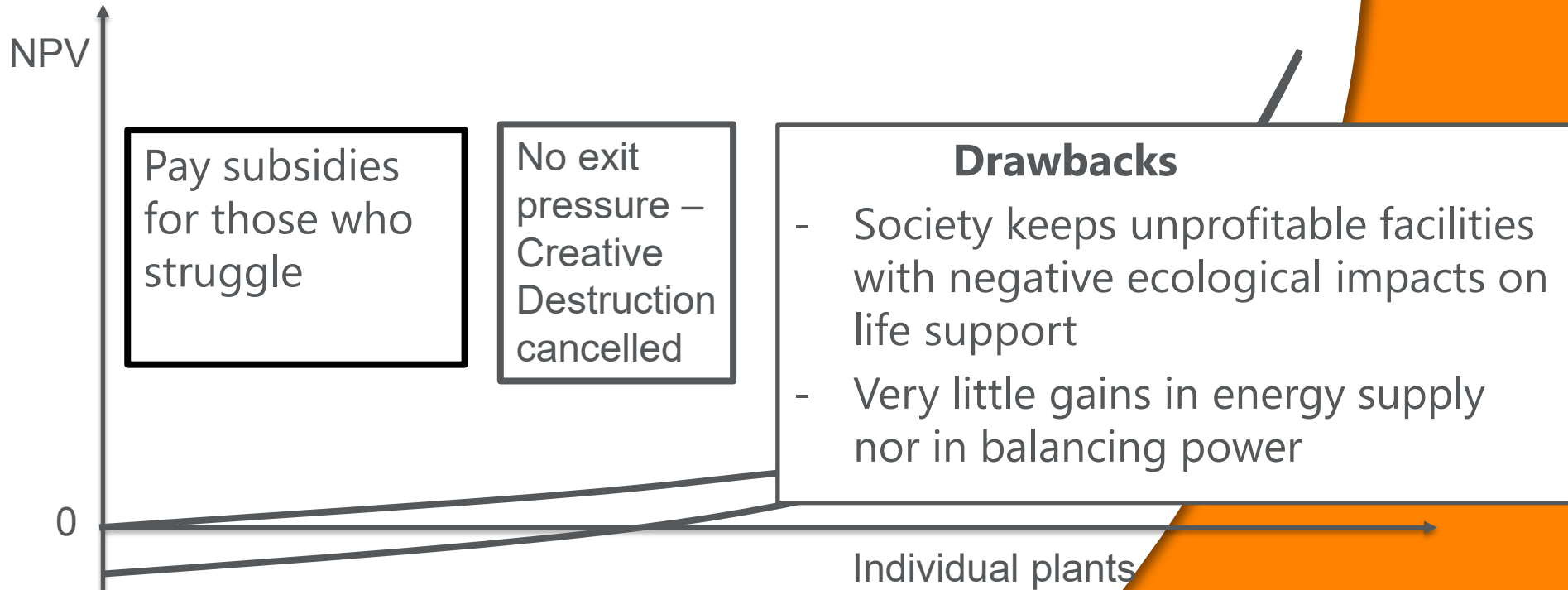
Add costly environmental measures to all



Add costly environmental measures to all



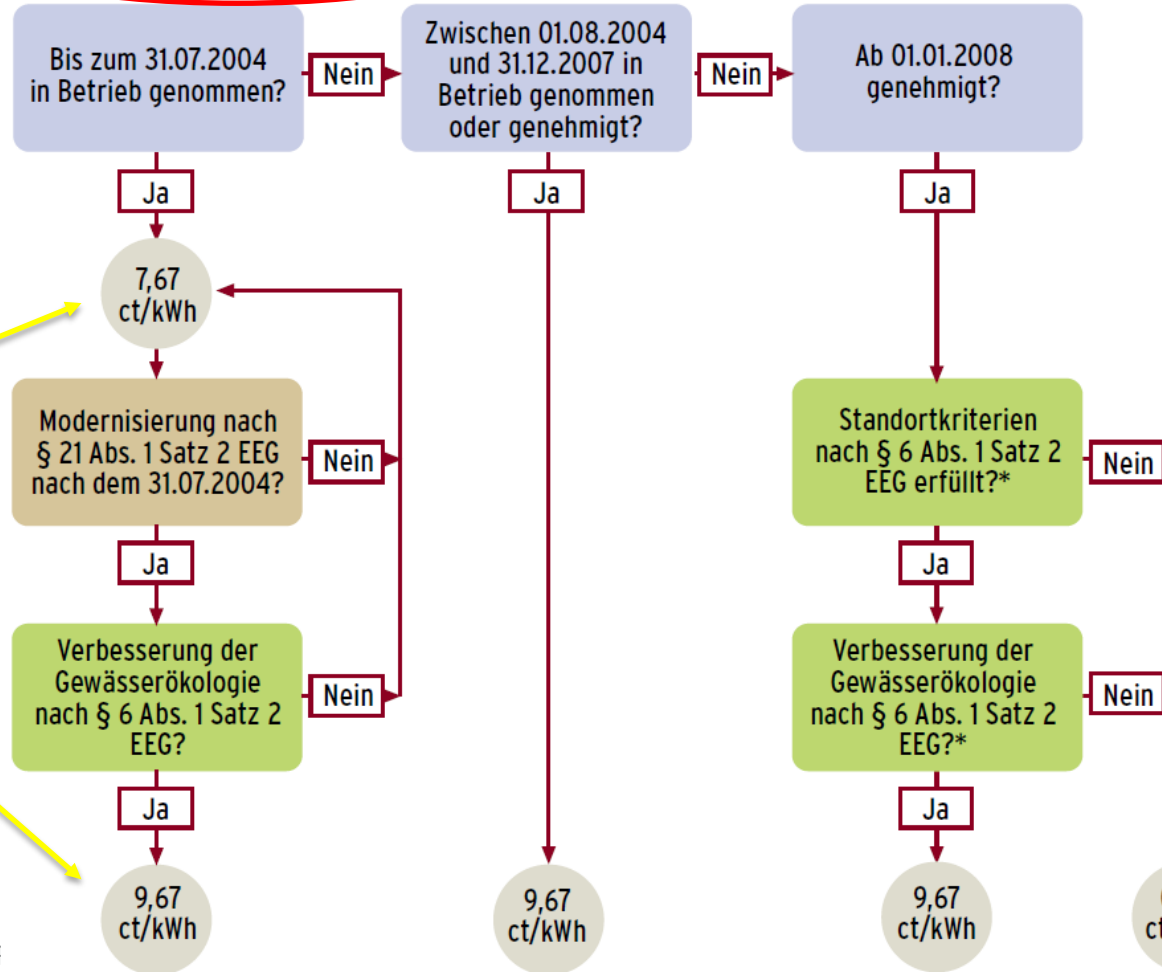
Add costly environmental measures to all



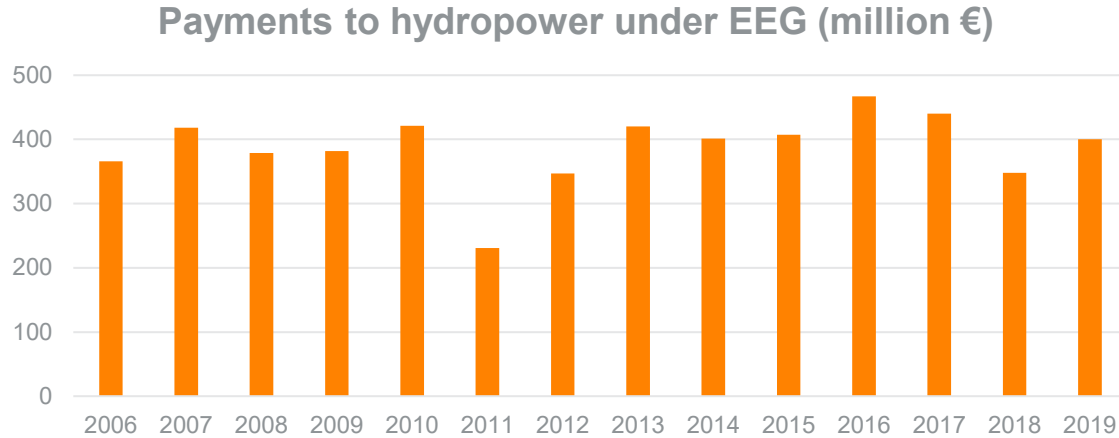
Wasserkraftanlage < 500 kW

EEG, Germany

Compare with Nordpool average system price 2008-2022: 4.32 ct/kWh



Payments from the EEG

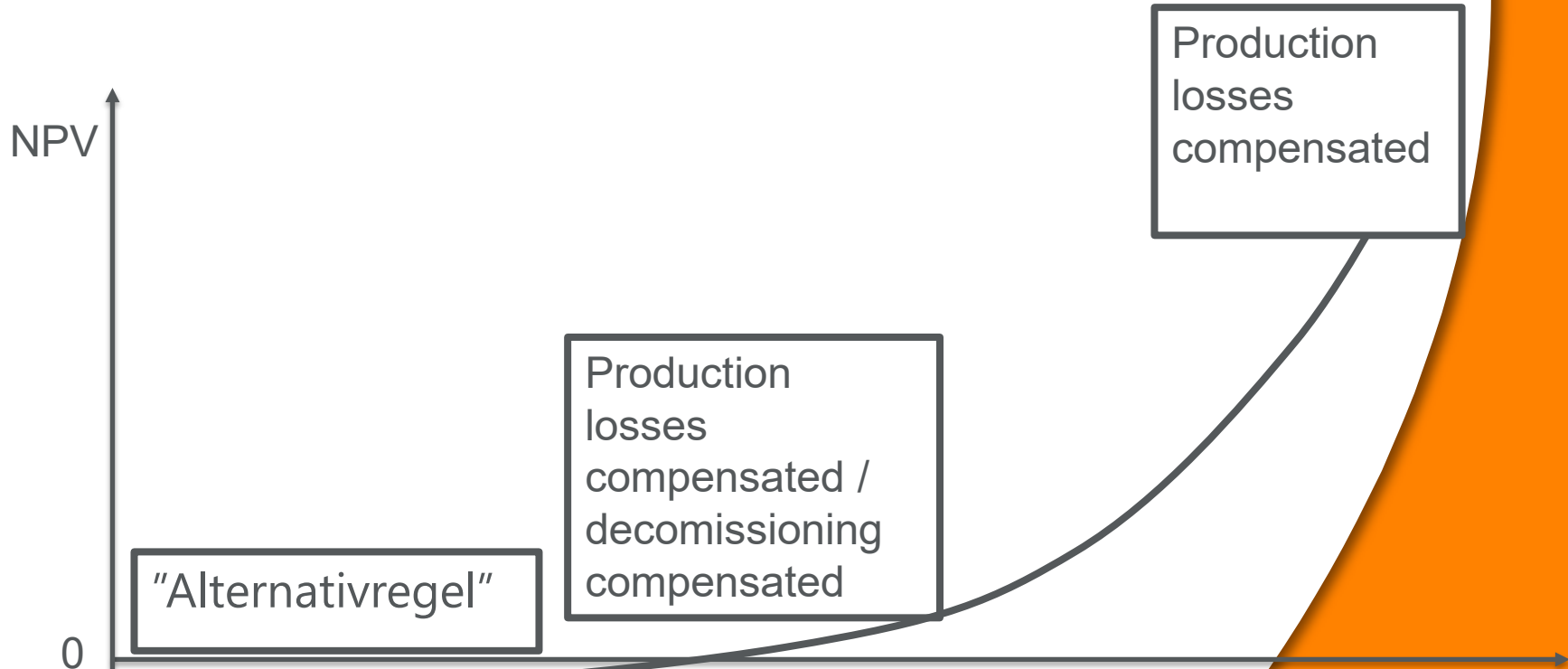


- In 2019 compensations paid for the production of 8 977 GWh (~35% of total hydro) – focus on the small ones
- EEG total payments in 2019 27.6 billion € (1.4% to hydro)
- The key impact may come from disturbing the exit dynamics – unless it actually is socially optimal to maintain all HPPs in production

Swedish national plan

- Revision of all permits to meet environmental standards
- Comprehensive multi-actor process
- Economics and there NPV, one dimension of the process
- Compensation of NPV of forgone production and construction costs (e.g., fish passages) up to 85%
- Explicit option for exit, ompensation based on NPV of the HPP
- Open access calculator SNURRAN helps assessing options

Approach serves the whole range of facilities



Two points on implicit incentives

1. For small, privately run HPPs the operating costs calculated by SNURRAN may be systematically higher
 - than they are
 - than they are considered to be.

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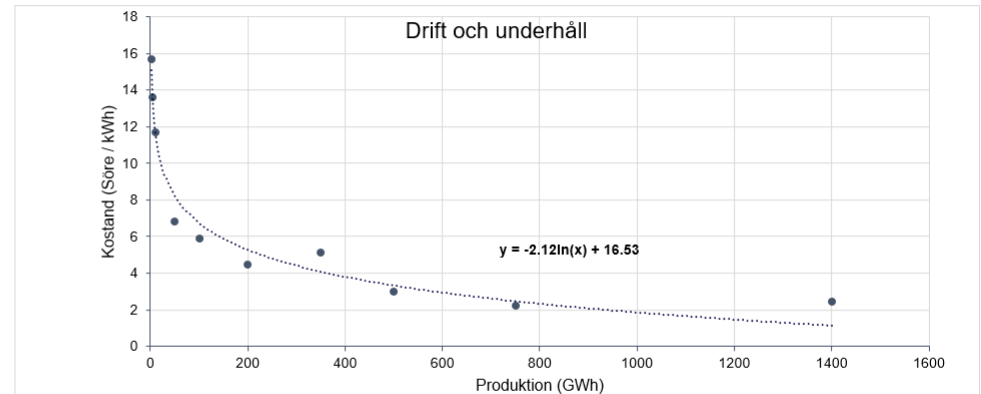
Drift och underhåll

Kostnad givet produktion om x GWh

2	Söre / kWh	15.71
5	Söre / kWh	13.63
10	Söre / kWh	11.69
50	Söre / kWh	6.85
100	Söre / kWh	5.90
200	Söre / kWh	4.50
350	Söre / kWh	5.13
500	Söre / kWh	2.99
750	Söre / kWh	2.24
1 400	Söre / kWh	2.46

Lutning kostnadskurva ($y = c * \ln(\text{GWh}) + b$) (2.12)
Intercept kostnadskurva ($y = c * \ln(\text{GWh}) + b$) 16.53

Faktiskt normalårsproduktion	GWh	0.34
Maximal applicerad normalårsproduktion	GWh	1 400.00
Minimal applicerad normalårsproduktion	GWh	2.00
Applicerad normalårsproduktion	GWh	2.00



Two points on implicit incentives

1. For small, privately run HPPs the operating costs calculated by SNURRAN may be systematically higher
 - than they are
 - Actual costs may be lower due to differences in operational standards, e.g. in safety procedures (number of employer present during facility visits etc).
 - than they are considered to be.
 - Value for own time? Facebook vs fixing the plant?
 - Smaller HPPs → from business economics to individual decision making (endowment effect)

Two points on implicit incentives

1. For small, privately run HPPs the operating costs calculated by SNURRAN may be systematically higher – Example
 - Assume 1 GWh production, 15% production loss if fishway
 - Anticipated production costs 5 000 €/yr, SNURRAN 14 139 €/yr
 - Cost fishway 1 000 000 €, cost decommissioning 400 000 €

	Costs to Fund	Anticipated costs to owner
Fishway	928 386 €	181 543 €
Decommissioning	862 576 €	270 284 €

Two points on implicit incentives

2. NPV affected by timing of costs, even in infinite time horizon. Normally used in investment decisions when timing is Now. Example:

- Assume infinite stream of net revenues 10 000 €/yr
- Big investment (200 000 €) every 30 years
- Next investment either this year or in 25 years
- Discount rate 5%

	NPV
First investment this year	-50 205 €
First investment in 25 years	133 160 €

Finland – voluntary retirement program

- No systematic revision process of (permanent) permits
- Sporadic tightening of conditions & enforcement of actions
- One of the action points of the governmental Nousu-program (2020-2023) has been buying out small facilities that are facing investments (low NPV)
- 50-50 financing between state and private donors

Finland – voluntary retirement program

- No systematic revision process of /

Efficiency
increase

0.0 %



Remove
investment

Results

Present value of the net revenue stream

653 439,29

€

-95 238,1

€

558 201,19

€

Also facilitated by an open access NPV calculator:
<https://kalahavainnot.luke.fi/en/vesivoimalaskuri>

Download XLSX

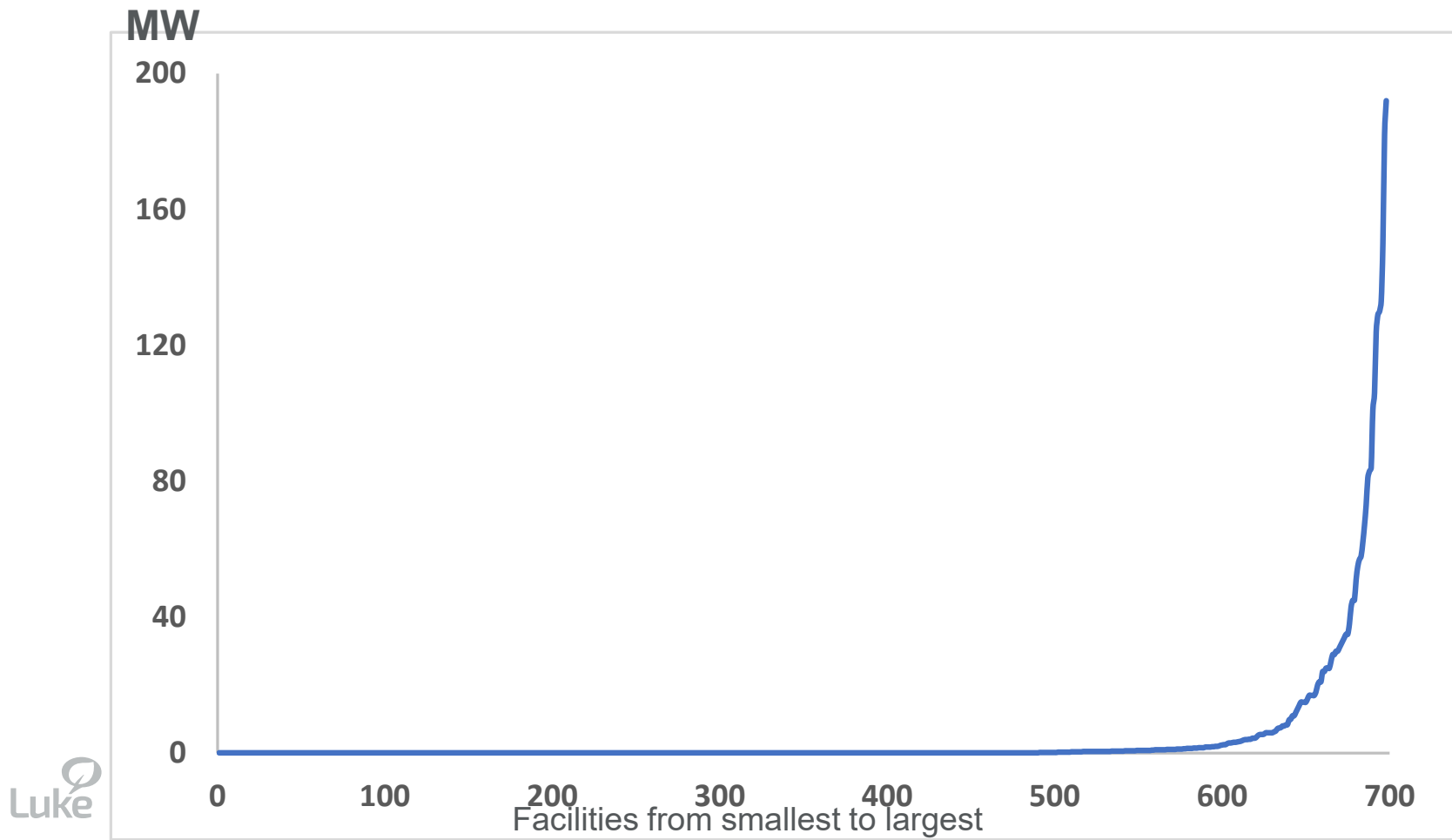
Electricity generated for
day-ahead markets

5,000 MWh/y

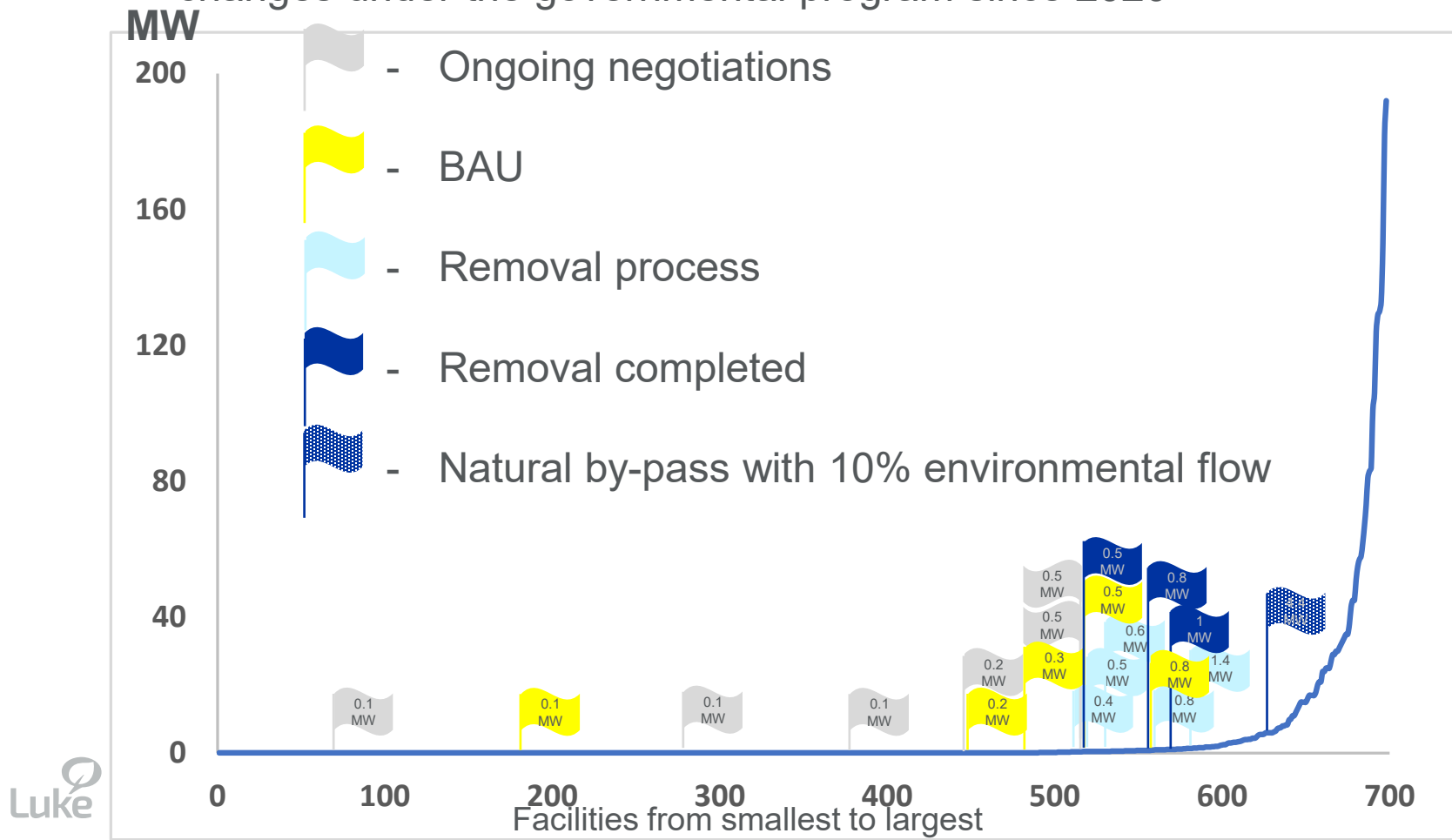
Average price of day-
ahead electricity

30.00 €/MWh

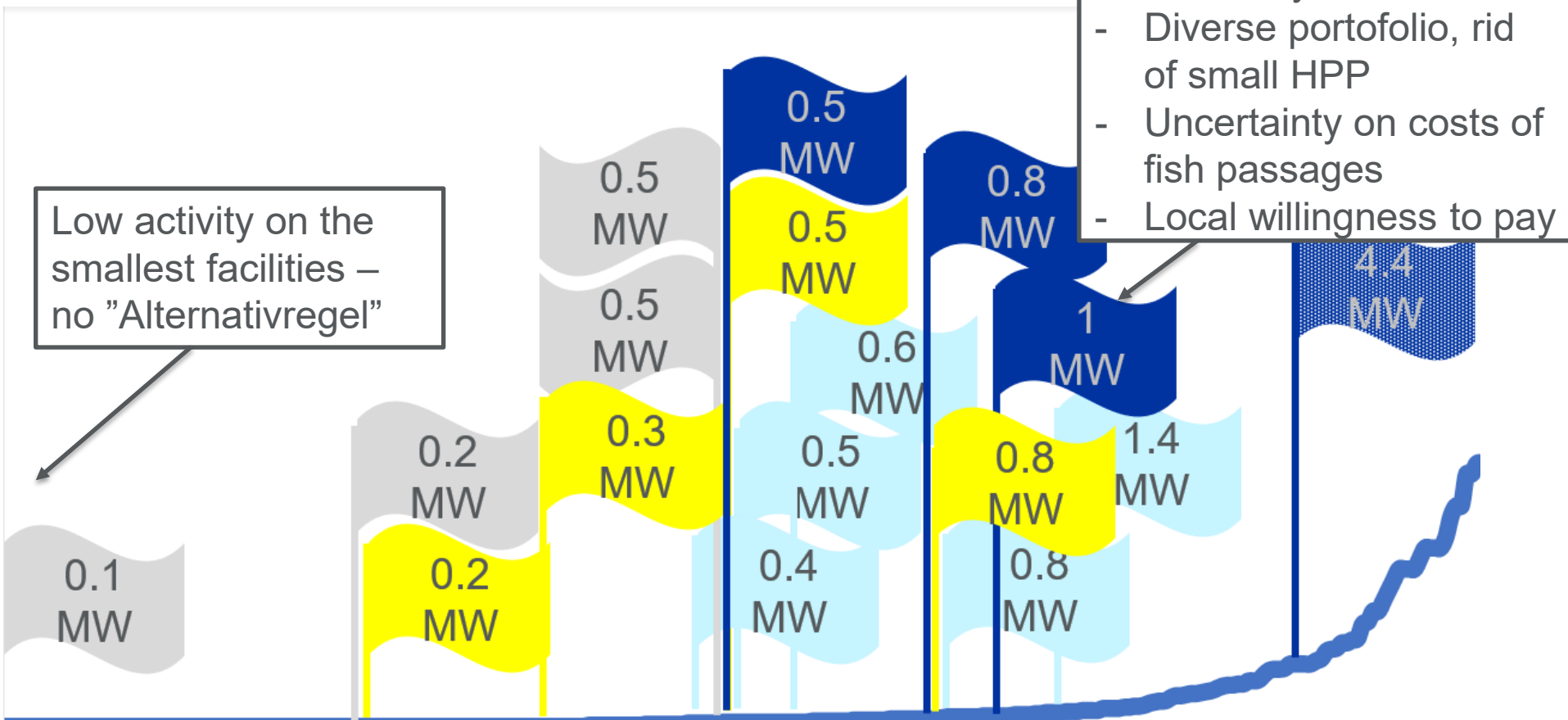
Size distribution of Finnish hydropower sector



Size distribution of Finnish hydropower sector – changes under the governmental program since 2020



Take home message from the retirement program

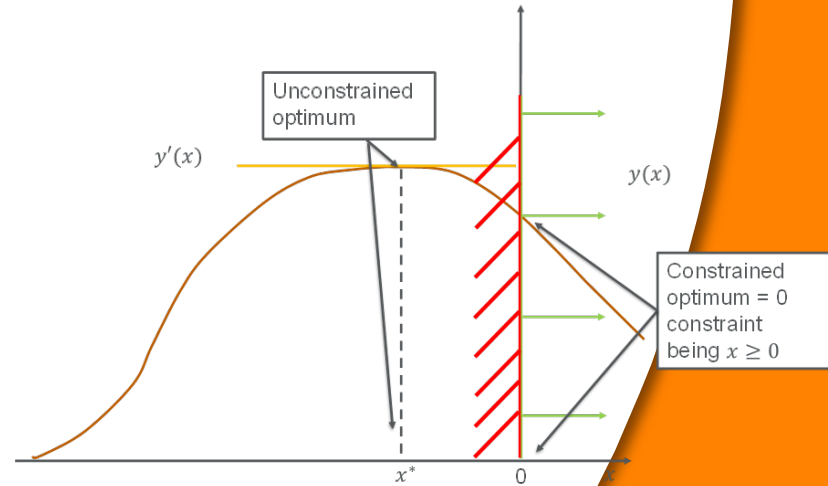


Take home from the retirement program

- Some good cost-efficiency promoting components
- No long term mandate
- Strategic incentives to misreport costs:
 - One-shot game: X owns just on facility
 - Repeated game: X own multiple potential facilities
- Should be completed with a more comprehensive revision process

Summary

- Scale should be recognized
- Optimization \rightarrow corner solutions



- Exit options should be explicitly addressed
- Existing policies should be analysed to identify their (un)intended effects on exit

Thank you!

References

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