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New start-up costs for our hydropower plants in NO4

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Agenda

- History and changes to the startup-cost sheet
- Canges to our startup-costs
- Our experiences using the startup-cost spreadsheet

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The history of the startup-cost sheet

- First version released by Sintef in 2002
  - Calculated average startup-cost
- Second version released By Sintef and Norconsult in 2011
  - By Thomas Welte, Sintef and Lars Eliasson, Norconsult
  - Introduced marginal startup-costs

Marginal vs. Average Startup-costs

Reabilitation cycles is the basis for calculation of startup-costs

Marginal startup-cost is a cost that isn't expected to change future rehabilitation cycles. -> Used for short term scheduling

Average start-up cost is expected to change the future rehabilitation cycles. -> Used for long term analysis.

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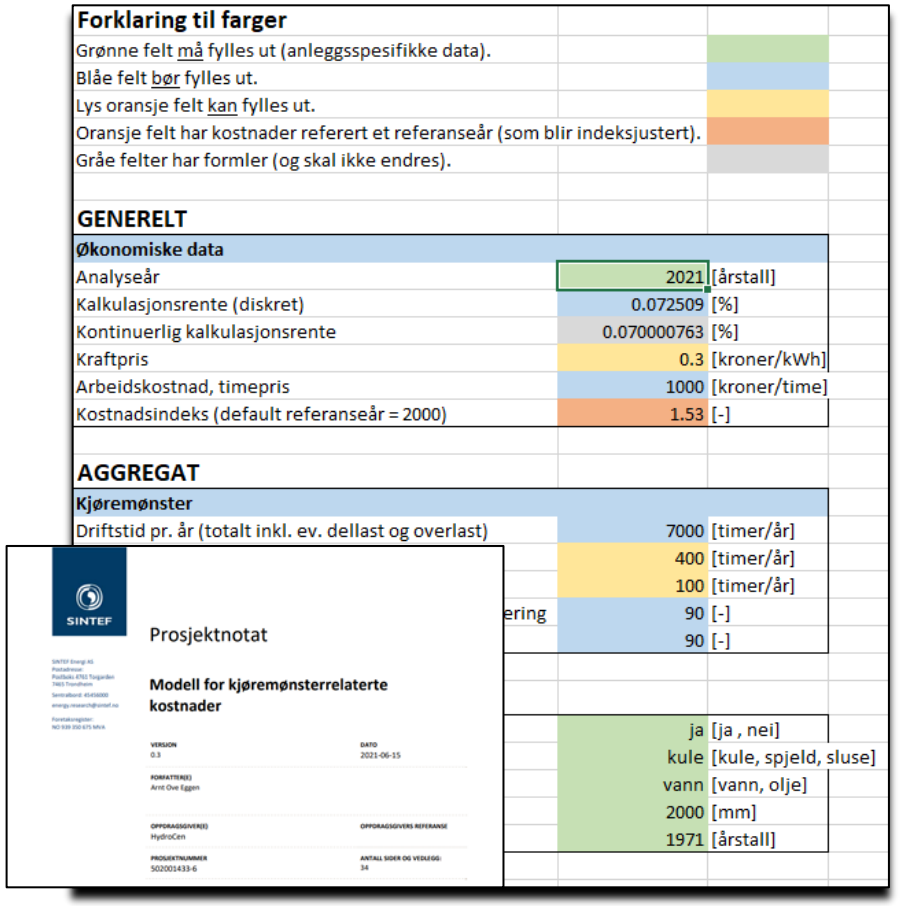
The history of the startup-cost sheet



Forklaring til farger		
Grønne felt må fylles ut (anleggsspesifikke data).		
Blåe felt bør fylles ut.		
Lys oransje felt kan fylles ut.		
Oransje felt har kostnader referert et referanseår (som blir indeksjustert).		
Gråe felter har formler (og skal ikke endres).		
GENERELT		
Økonomiske data		
Analyseår	2021	[årstall]
Kalkulasjonsrente (diskret)	0.072509	[%]
Kontinuerlig kalkulasjonsrente	0.070000763	[%]
Kraftpris	0.3	[kroner/kWh]
Arbeidskostnad, timepris	1000	[kroner/time]
Kostnadsindeks (default referanseår = 2000)	1.53	[-]
AGGREGAT		
Kjøremønster		
Driftstid pr. år (totalt inkl. ev. dellast og overlast)	7000	[timer/år]
	400	[timer/år]
	100	[timer/år]
ering	90	[-]
	90	[-]
	ja	[ja , nei]
	kule	[kule, spjeld, sluse]
	vann	[vann, olje]
	2000	[mm]
	1971	[årstall]

SINTEF

Prosjektnotat

Modell for kjøremønsterrelaterte kostnader

- New release to Hydrocen in 2021
  - By Arnt Ove Eggen, Sintef
- New features:
  - Technical state of turbine and generator
  - Expected duration of off-line period
  - Costs for producing at partial load

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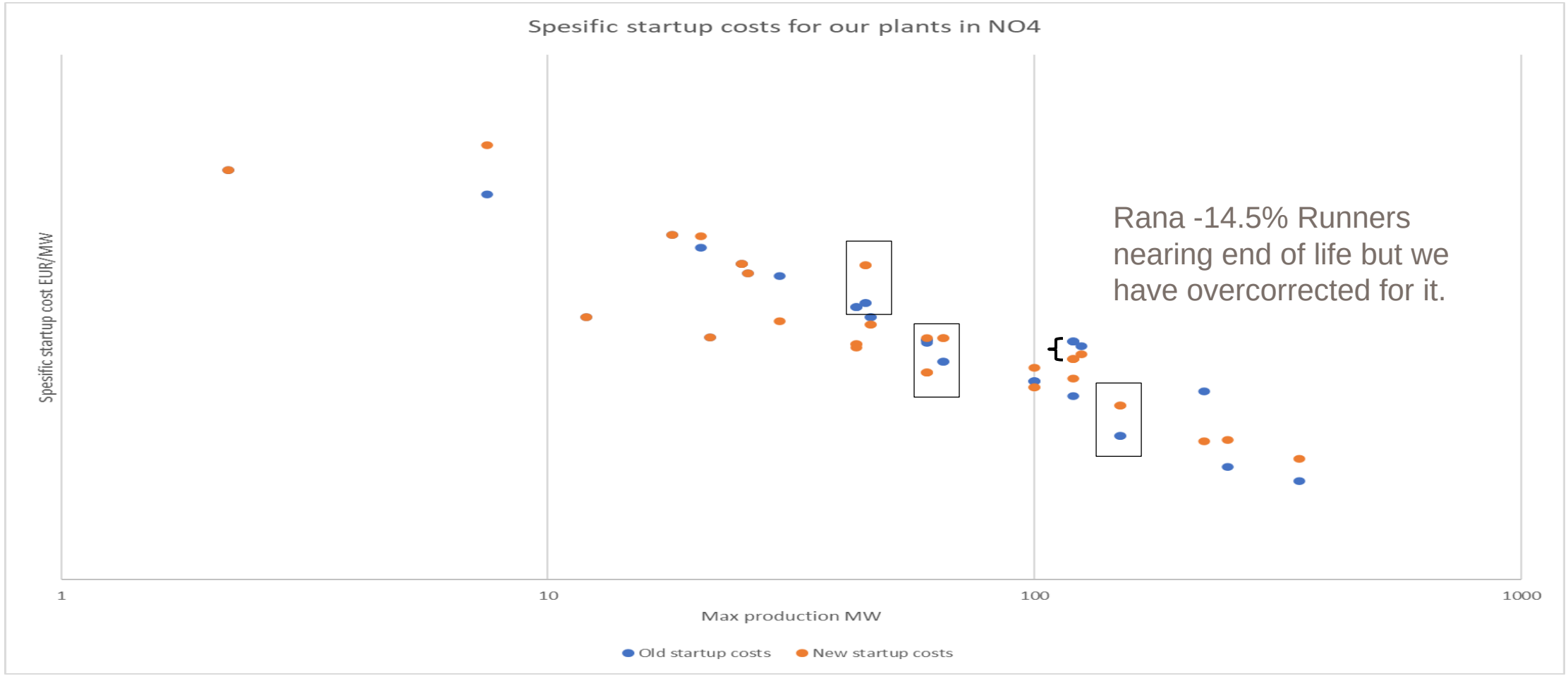
General change of start-up costs



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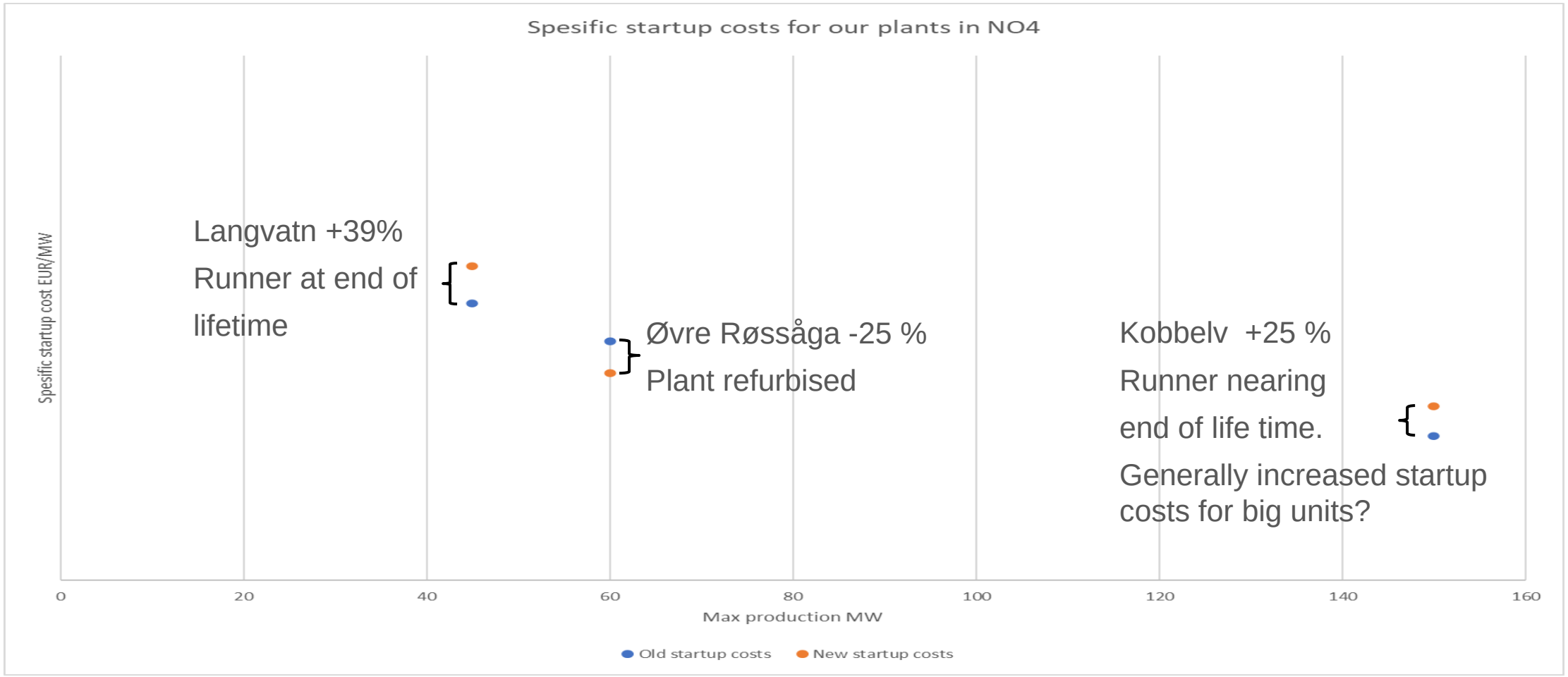
Changes in start-up costs for some spesific units



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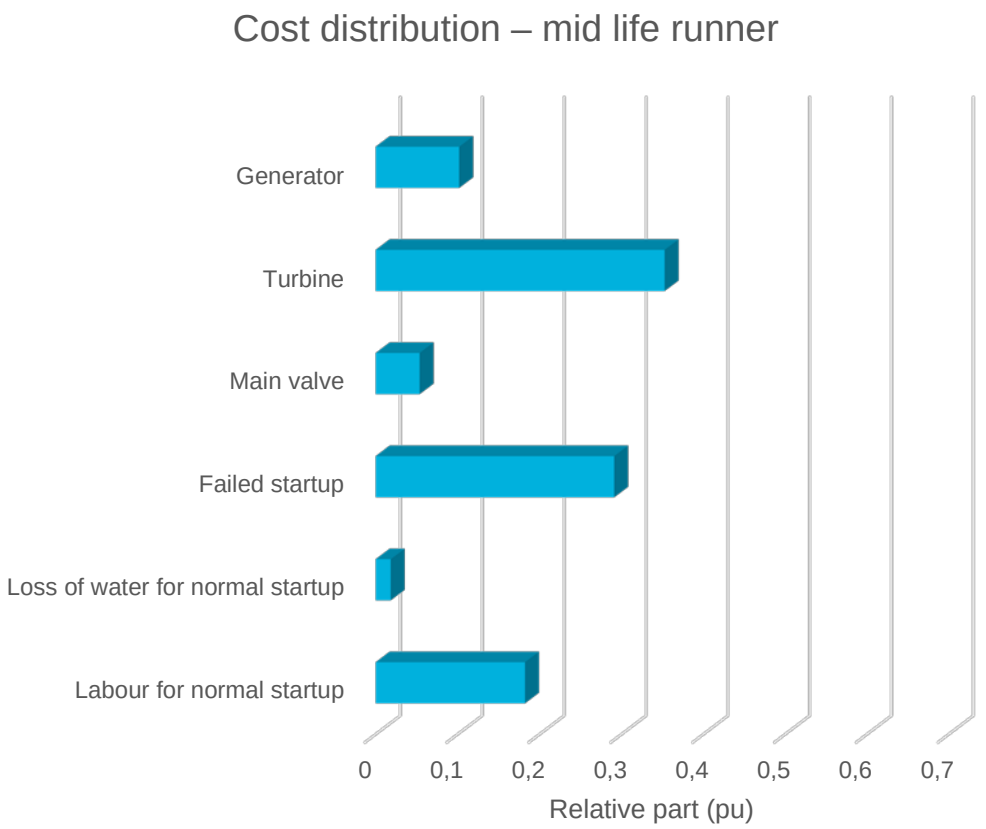
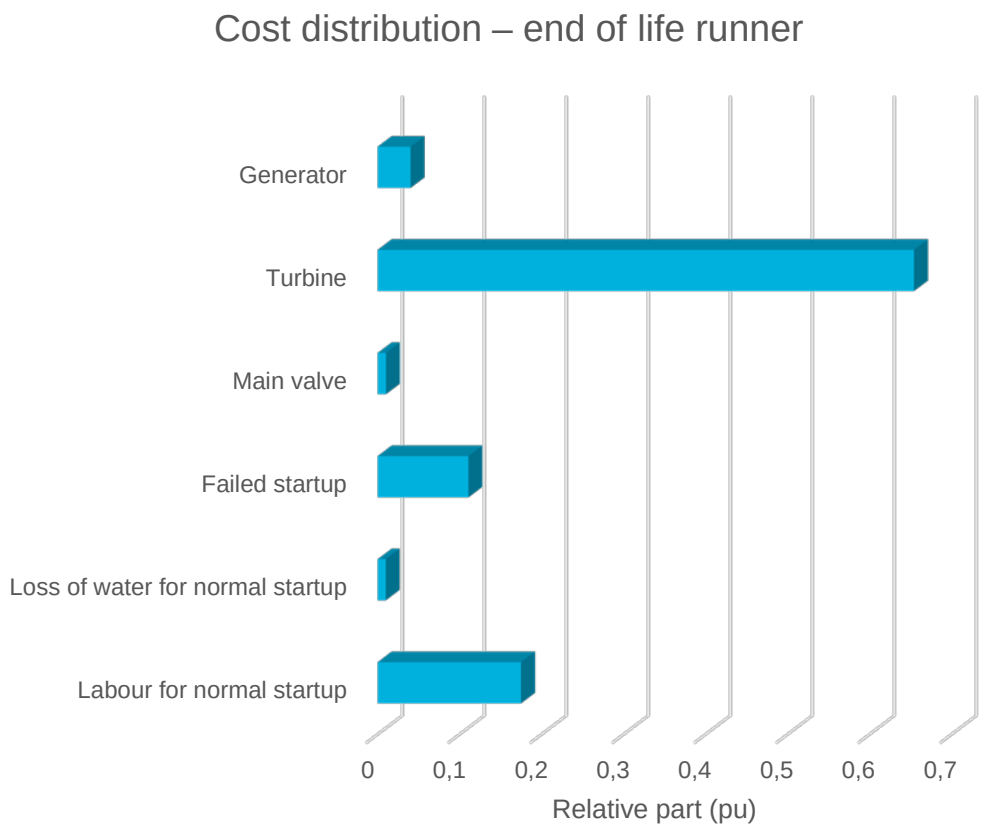
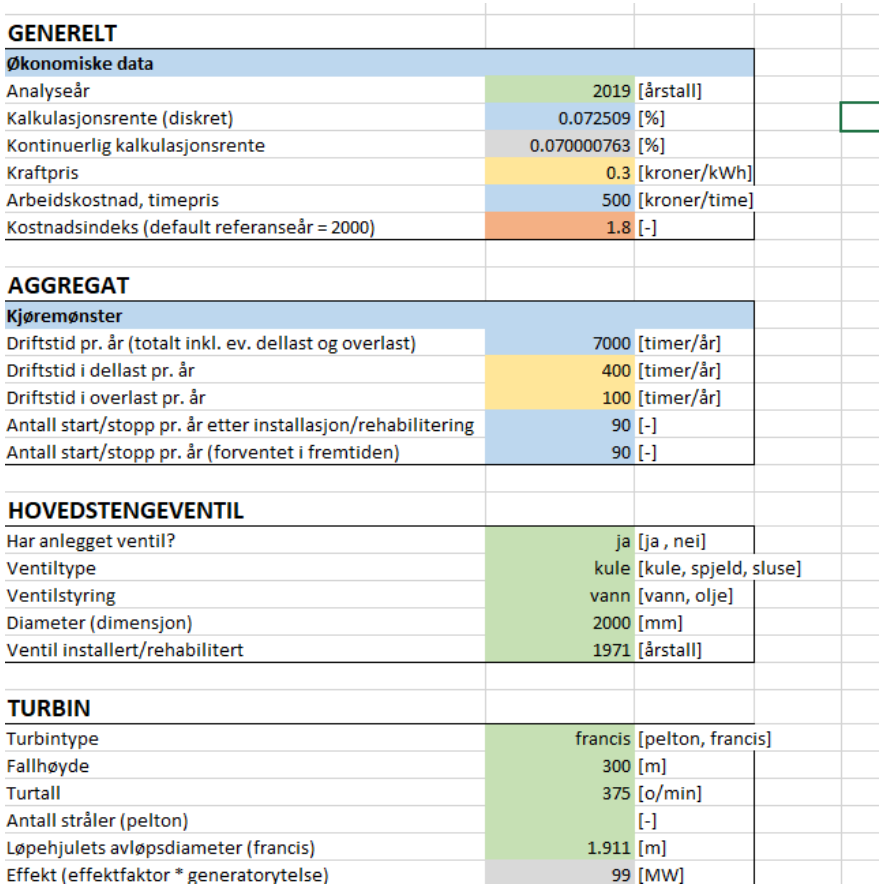
Distribution of startup-costs



Distribution of startup-costs



Our experiences using the spreadsheet



GENERELT		
Økonomiske data		
Analyseår	2019	[årstall]
Kalkulasjonsrente (diskret)	0.072509	[%]
Kontinuerlig kalkulasjonsrente	0.070000763	[%]
Kraftpris	0.3	[kroner/kWh]
Arbeidskostnad, timepris	500	[kroner/time]
Kostnadsindeks (default referanseår = 2000)	1.8	[-]
AGGREGAT		
Kjøremønster		
Driftstid pr. år (totalt inkl. ev. dellast og overlast)	7000	[timer/år]
Driftstid i dellast pr. år	400	[timer/år]
Driftstid i overlast pr. år	100	[timer/år]
Antall start/stopp pr. år etter installasjon/rehabilitering	90	[-]
Antall start/stopp pr. år (forventet i fremtiden)	90	[-]
HOVEDSTENGEVENTIL		
Har anlegget ventil?	ja	[ja , nei]
Ventiltype	kule	[kule, spjeld, sluse]
Ventilstyring	vann	[vann, olje]
Diameter (dimensjon)	2000	[mm]
Ventil installert/rehabilitert	1971	[årstall]
TURBIN		
Turbintype	francis	[pelton, francis]
Fallhøyde	300	[m]
Turtall	375	[o/min]
Antall stråler (pelton)		[-]
Løpehjulets avløpsdiameter (francis)	1.911	[m]
Effekt (effektfaktor * generatorytelse)	99	[MW]

- The spreadsheet is easy to use
- Can be challenging to find the right numbers to put into the general section
- The information about the units is quite easy to understand, and similar with earlier versions of the spreadsheet.
- We used about 0.5 hours per unit to include the most relevant numbers.

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Our experiences using the spreadsheet

Løpehjulets avløpsdiameter (francis)	1.911	[m]
Effekt (effektfaktor * generatorytelse)	99	[MW]
År for førstkommende rehabilitering	2020	[årstall]
Teknisk tilstand (tilstandskarakter)		
Løpehjul	2	[-]
GENERATOR		
Merkeytelse	110	[MVA]
År for førstkommende rehabilitering av statorvikling	2020	[årstall]
Merkespenning	12	[kV]
Teknisk tilstand		
Statorvikling	2	[-]
Stator blikkpakke	2	[-]
Polvikling	2	[-]
Kortvarig stopp?	USANN	
Tid til "kald start"	6	[timer]
Varighet av stillstand	4	[timer]

- The technical state is a new feature and we like it.
- Long time to update
- A lot of copy and paste when updating might lead to errors.
- We would like the sheet to be more scalable or/and integrated in the short-term models

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