



E-Masterplan

Recommendations for final system choice

29th of March 2022 Utrecht

Herman Sibbel, Leen Roos, Florian Simonsen



Introduction

Agenda:

10.00 – 10.15	Introduction + working method agreement (Herman Dorst)
10.15 – 10.30	To achieve today (Herman Dorst)
10.30 - 11.00	E-power requirements (Leen Roos)
11.00 – 11.30	Short term options (Florian Simonsen)
11.30 – 11.45	Coffee break
11.45 – 12.15	Long term options (Herman Sibbel)
12.15 – 13.00	System choice (general) (Leen Roos)
13.00 – 14.00	Lunch
14.00 – 15.45	Result for the different scenario's, including costs & time schedule (Herman Sibbel / Leen Roos)
15.45 – 16.00	Format final presentation (Herman Sibbel)

Working method agreement



To achieve today

- Provide overview of outcomes so far
 - E-power requirements
 - Short term options
 - Long term options
 - System choice: new installations
 - Recommended options per scenario
- Agree on recommendations for final system choice
- Agree on remaining work of Movares and format for final presentation feasibility study



E-power requirements

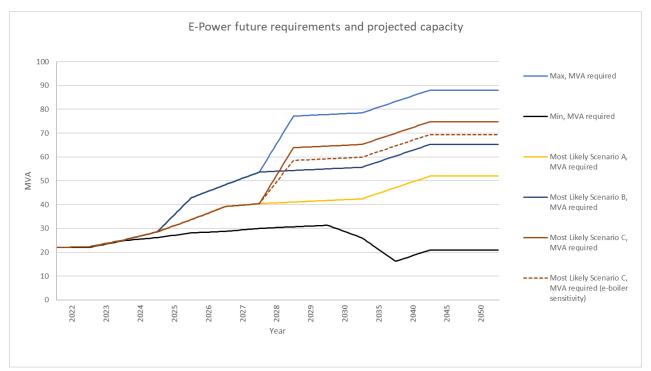
Scenarios

	Maximum Scenario	Minimum Scenario (Campus only)	Most likely Scenario A	Most likely Scenario B	Most likely Scenario C (fossil free future)
	All known projects continue	No new projects, all large-scale production stops after 2030	Main projects continue + CoRe	Scenario A + New partner + HNP	Scenario A + E-boiler for steam
	T-	<u> </u>		I	1
Campus + extension	yes	yes	yes	yes	yes
Bioproces Pilot Facilities	yes	yes	yes	yes	yes
DFS-DBC extension	yes	yes	yes	yes	yes
DSM processes	yes	no	yes	yes	yes
Centrient processes	yes	no	yes	yes	yes
CoRe project	yes	no	yes	yes	yes
new partner, company X	yes	no	no	yes	no
HNP	yes	no	no	yes	no
Electric boiler for steam	yes	no	no	no	yes



E-power requirements

Connection requirements per scenario

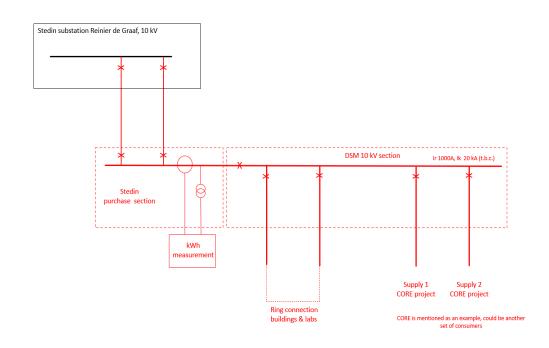


 Agree on preferred scenario



Short term options (result of a longlist of 50 ideas)

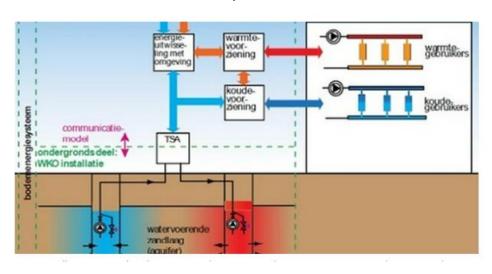
_	Reinier de Graaf
Implementation time	2-3 years
Contribution capacity	10 MVA
Costs (indicative)	3,5 M€ (excl. connection on site)
	regret costs
Pros	10 MVA
	Requires island operation and separation from existing 10kV installation
	Relatively long realization time
Cons	Not supported by Stedin (1 WOZ)
	Regret costs (depending on application)
	Not beneficial for tax reasons
	Only for special applications





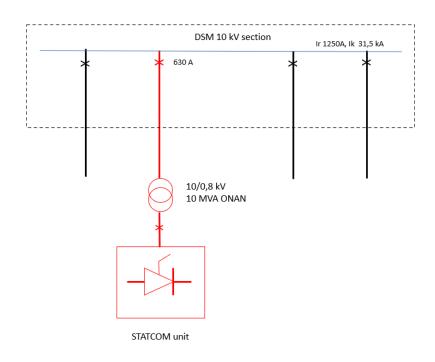
	WKO
	(Heat/Cold Storage)
	(Under investigation)
Implementation time	2 years
Contribution capacity	2 MVA (t.b.c.)
Costs (indicative)	1-2 M€ (t.b.c.)
	no regret costs
	Implemented in 2 years
Pros	Optimizes energy-efficient use of heat/cold
	Applicable for various users
Cons	Requires permit from province Requires cooperation of Centrient Needs 1 year to create balance
	To be confirmed

Principe WKO





	Statcom
Implementation time	1-2 years
Contribution capacity	2.5 MVA
Costs (indicative)	1,25 M€ (excl. local buildings) no regret costs
Pros	Implemented in 1-2 years Increases power quality and energy efficiency (also for long term)
Cons	Requires system studies (grid data + load profiles)
	Recommended





Remaining options

	Reduced redundancy (temporary)
Implementation time	1-2 years
Contribution capacity	4 MVA (indication)
Costs (indicative)	100-150k€
,	no regret costs
Pros	Implemented in 1-2 years
1103	Low costs (short term)
	Chance of outage: 1x per 15 years (overload of cables and transformers)
Cons	Temperature measurement and protection necessary
	Overload could lead to
	accelerating aging
	Participation in load shedding is required
	Recommended as temporary
	measurement in combination
	with recommendations

use of CHP		
(temporary)		
0 years		
7 MVA		
No addional CAPEX		
no regret costs		
Immediately available		
No CAPEX costs		
Optimal use by generating both electricity and heat		
Additional use of fossil fuels		
Relatively high operational costs		
Recommended		











- What is the status of CHP?
- Prioritization of options for short term



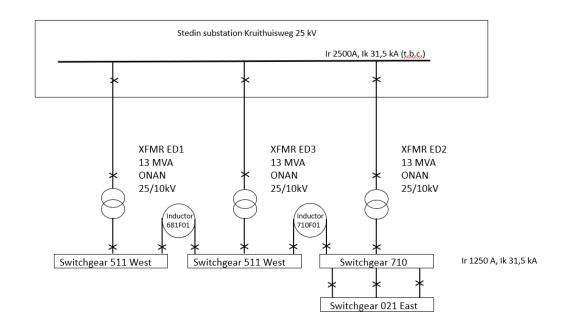


Break

Tot zo!

Option one to one replacement of existing: Stedin 25 kV, Kruithuisweg

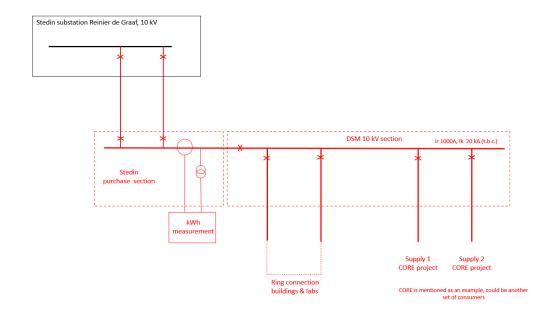
	Not recommended (for benchmark only)
-	No additional value, except renew of assets
+	Realization within 2 years
Risks	Not supported by Stedin
	Permits (delay)
OPEX	150k€/year + 560k€/year t. costs
CAPEX	15 M€ (t.b.c.)
Implementation time	1-2 years
Distance	5 km
Connection capacity	Existing 26 MVA





Option 1A: Stedin 10kV, Reinier de Graaf

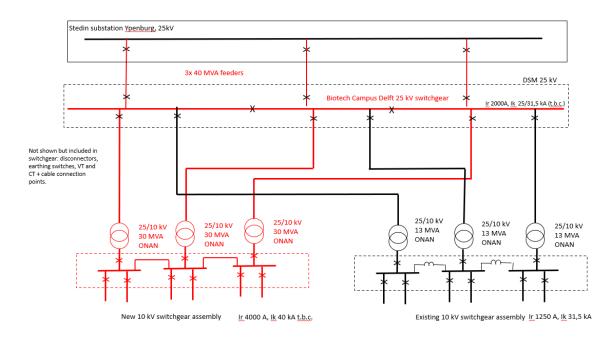
Connection capacity	Additional 10 MVA (-> in total 36 MVA)
Distance	3 km
Implementation time	3 years
CAPEX	3.5 M€
OPEX	230k€/year (9 + 221 k€)
Risks	Equalization currents
	Delay of implementation
+	Realization within 3 years
	Requires island operation and
	separation from existing grid
	Not supported by Stedin (1 WOZ)
-	Regret costs (depending on application)
	Not beneficial for tax reasons
	Not recommended
	(special application only)





Option 4A: Stedin 25kV, Ypenburg

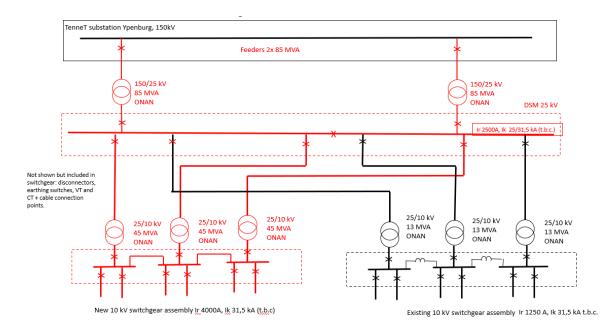
Connection capacity	60 MVA
Distance	4,2 km
Implementation time	< 3 years
CAPEX	40 M€ (17 + 23)
OPEX	1,4 M€ (0,11 + 1,3 M€)/year
Risks	Risk of not enough connection capacity available (congestion, bays are not available)
+	Lower CAPEX Realization within 3 years
-	Restriction with Stedin limited to 60 MVA (total new capacity) Check!
	Recommended





Option 5A: TenneT 150kV, Ypenburg

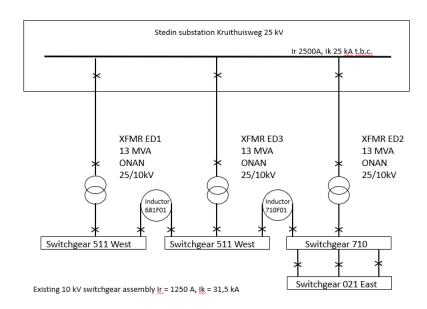
Connection capacity	85 MVA
Distance	4,2 km
Implementation time	within 4-5 years
CAPEX	60,5 M€ (31 + 29,5)
OPEX	2,27 M€ (0,17 + 2,1 M€)/year
Risks	Risk of no connection capacity available (congestion, bays are not available)
+	Higher reliability
	"More" capacity
	Higher CAPEX costs
-	Longer implementation time
	Recommended

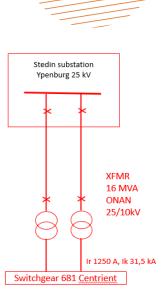




Option 6B: Centrient 25kV, Ypenburg

Connection capacity	Additional 16 MVA (-> in total: 52 MVA)
Distance	4,2 km
Implementation time	3 years
CAPEX	11 M€
OPEX	410k€ (60k + 350k€)/year
Risks	Equalization of currents
+	Limited costs for the short term
	GPLK cables fail (>45 years old) for existing plant
-	System separation (additional costs) needed from Centrient
	Additional connection investment necessary for expansion of site
	OPEX implications (tax & summation)
_	Not recommended

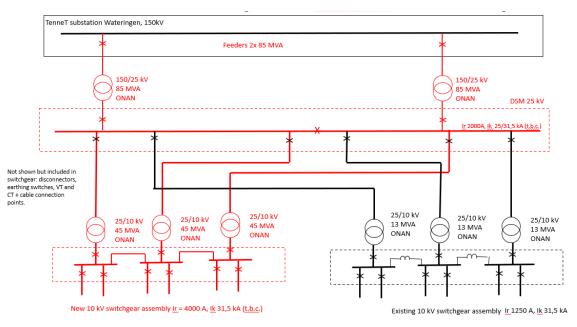






Option 7: TenneT 150kV, Wateringen

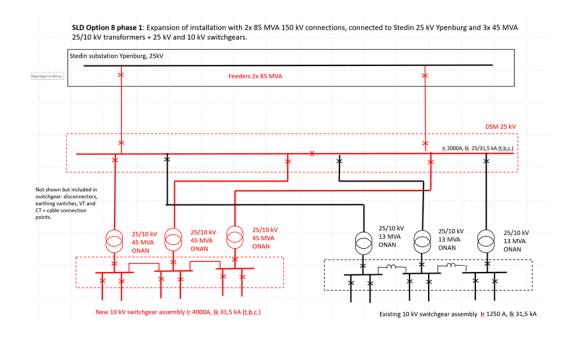
Connection capacity	85 MVA
Distance	3,5 km
Implementation time	< 5 years
CAPEX	59 M€ 29,5 + 29,5)
OPEX	2,25 M€ (0,15 + 2,1 M€)/year
Risks	Implementation time
	Lower Capex costs
+	Higher reliability
	"Unlimited" capacity
-	Cable route with more natural obstacles
	Implementation time
	Recommended





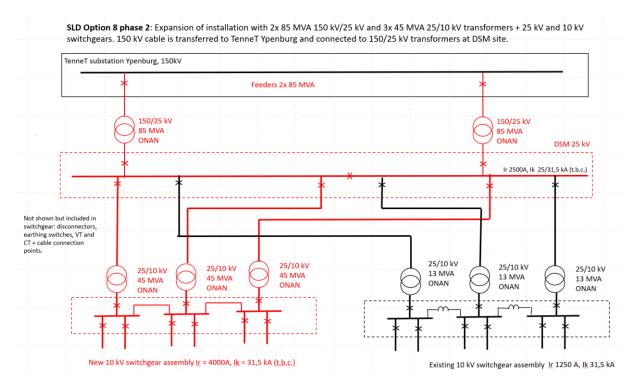
Option 8: Stedin 25kV + TenneT 150kV, Ypenburg

Connection capacity	60 MVA (phase 1), 85 MVA (phase 2)
Distance	4,2 km
Implementation time	< 3 years phase 1 + < 2 years phase 2
CAPEX	>>60 M€
OPEX	2,3 M€ (0,2 + 2,1 M€)/year
Risks	Risk of no connection capacity/space available for the upgrade
	Initial CAPEX limited
+	Scalable solution
	Overall CAPEX high
-	Unfavorable cable sizing
	Implementation time
	Not Recommended





Option 8: Stedin 25kV + TenneT 150kV, Ypenburg





Overview OPEX

	Stedin HS+TS/MS	Stedin HS+TS/MS	TenneT
	1A/6B	4A	5A/7
	€ 8.745 (standaard aansluiting tot	1% investeringskosten (z. toek.	1% investeringskosten (z. toek.
Periodieke aansluitvergoeding	10MVA) /jaar	vervanging) -> ca. 114.024 /jaar	vervanging) -> ca. 143.320 /jaar
Transportkosten			
kWcontract	€ 24,06 /kW/jaar -> 90% van 10	€ 24,06 /kW/jaar -> 90% van 60	€ 27,24 /kW/jaar -> 90% van 85
	MVA -> € 221.400 /jaar	MVA -> € 1.299.240 /jaar	MVA -> € 2.083.860 /jaar
kWmax	2,6747 /kW/maand	€ 2,6747 /kW/maand	€ 2,79 /kW/maand
vastrecht	€ 2.760,00 /jaar	€ 2.760,00 /jaar	€ 2.760,00 /jaar
Meetverantwoordelijkheid			
Balanceringskosten			



Overview

E-Masterplan MT - LT options Technically Discard Option: 2, 3, 4B, 4C, 5B, 5C Technical not feasible feasible (Short Circuit. Extensions of current 10kV local grid) **Technical system** Option: 6A, 6B Dedicated grid Split DSM and Discard, as no Yes separation needed + Centrient Centrient Grid (gain: 'Claim' or 'Go' double costs max 14 MVAj from Centrient No added value Max 1,75 MVA Option: 1B (Watertoren) Connect System separation dedicated users Yes Option: 1A (Reinier de Graaf) needed + temporarily + Max 10 MVA double costs Feasible option, with limited costs and Option: 4A (Ypenburg) Stedin New capacity capacity connection below 60 MVA Option: 5A (Ypenburg) Option 5A feasible option, with high costs + more capacity Option: 7 (Wateringen) Option 7 > feasible TenneT Option 8 > cost + risk too high connection Scalable need No Option 9 not accessible Option 8: Ypenburg 25 and 150 k from <60 to Option: 9 (Kruithuisweg) Yes



System choice: new installations (4A + 5A/7)

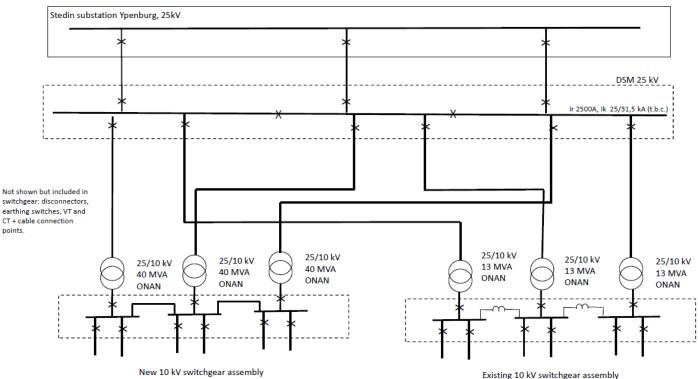
Overview

	4A	5A	7												
SL	New power supply cables from	New power supply cables from TenneT Ypenburg	New power supply cables from TenneT Wateringen												
Electrical supply Installations	Stedin Ypenburg	Installing 2 new 150/25 kV 80 MVA transformers								Installing 2 new 150/25 kV 80 MVA transforme					
Inst	New 25 kV installation for DSM site														
plly		New 10 kV switchgear													
dns	Installing	3 new 25/10 kV 45 MVA transf	ormers												
ical	Reusing existi	ng 3 25/10 kV transformers rat	ed 13 MVA												
ectr	Installation of new 25	kV cables for the power supply	of the transformers												
E	In	stallation of new 10 kV cables													
	Buildings for new electrical equipment														



System choice: Option 4A

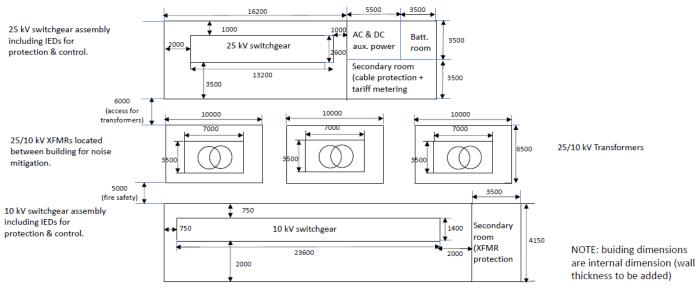
SLD for Option 4A t.b.v. 25 kV voeding vanuit Stedin Ypenburg Version 1.0 (11-03-2022)





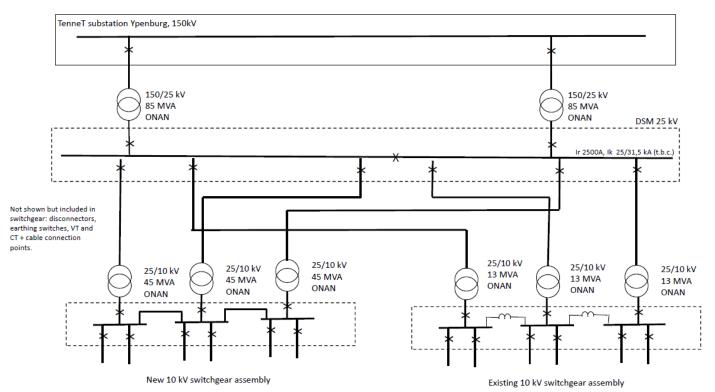
System choice: Option 4A

Space occupation option 4A: 40 x 40 m (approximately)



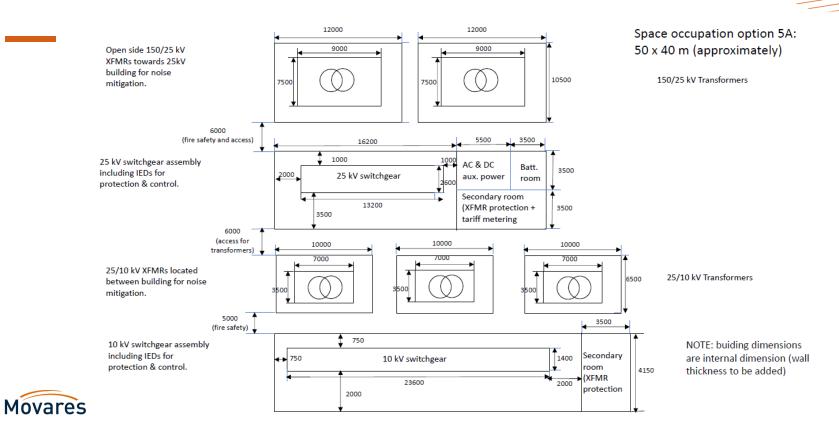


System choice: Option 5A/7





System choice: Option 5A/7



System choice: new installations (4A + 5A/7)

Cables

_	4A	5A/7
suitable for	85 MVA (incl. redundancy requirement)	85 MVA (incl. redundancy requirement)
cable isolation	18/30 kV, XLPE insulated	87/150 kV, XLPE insulated
cables	3 x 42,5 MVA at 25 kV	2 x 85 MVA at 150 kV
Cable current capacity	I = 980 A	I = 327A
Related cable	 3x1x1600 Al, trefoil installation Cables for Stedin: probably be provided with cross bonding Cables for DSM: of relative short length; require earthing at both sides (one side with surge arrestor) 	3x1x300 Al, trefoil installation, with cross bonding
Other	 Cable cross section is selected 2 sizes higher than the required minimum cable size. Reasons: Economic sizing requires a higher size (minimum 1 step, minimizing losses) Thermal resistance is selected as 1,0 Km/W (i.s.o. 0,75 as standard for west part of NL). It is expected that part of the cable route will be in (brought-on) sand. Minimum bend radius 1500 mm. Minimum basement depth. 	Cable size is minimum cable size for 170 kV (at least for some manufacturers)



System choice: new installations (4A + 5A/7)

Busbar

- Switchgear bus bar suitable for rated capacity of transformers + CHP generators.
- Switchgear bus bar separated in sections for optimum service of supply (N-1)





System choice: new installations

EMC



- Cable installation: cables in trefoil (HV/MV), or bounded together per circuit (MV/LV)
- All in- and outcoming low voltage and control cables are grounded (cable sheath) upon entering a building
- Proper cable routing and cable connections in line with IEC 61000-5 recommendations
- Housing of HV/MV/LV and control equipment in metal housings
- Equipotential earthing for all steel parts
- Adequate location of HV/MV/LV and control equipment in buildings and rooms, separation is different rooms to avoid interference



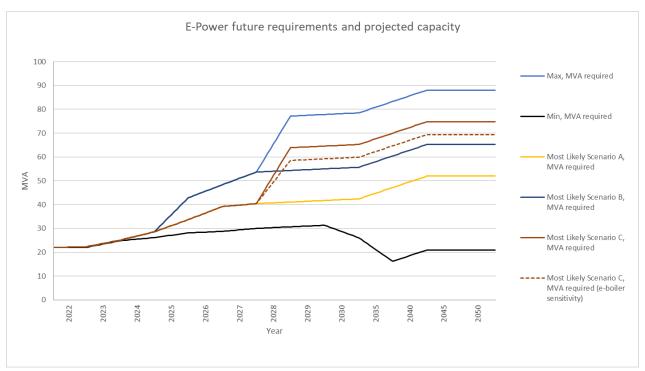


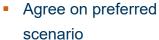


Lunchbreak

E-power requirements

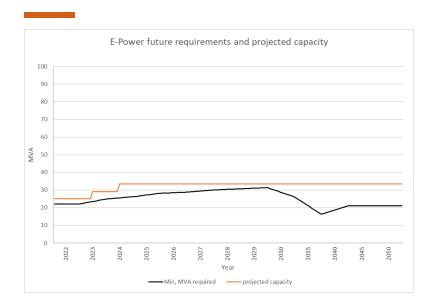
Connection requirements per scenario







Minimum Scenario



Risks:

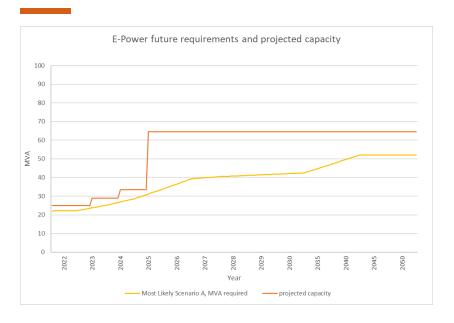
- You keep old installations, old transformers etc.
- Redundancy is a temporary solution only

	year	options	CAPEX
	2023	Lower redundancy (temporary)	100-150k€
short term	2024	Statcom	1,25 M€
	2024	WKO	1,5 M€ (tbc)
long term	ong term - none		-
<u>'</u>			ca. 3 M€

Min	Scenario	2022 2023			2024								
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Opti	Option Lower redundancy (termporary)												
Opti	ion Statcom												
1	basic engineering option Statcom												
2	equipment sizing, incl. specification												
3	main equipment purchase / reservation												
4	detailed engineering												
5	construction												
6	testing & commissioning												
Opti	ion WKO												
1	basic engineering and grondonderzoek												
2	Permitting process												
3	realisation												



Most Likely Scenario A



Risks:

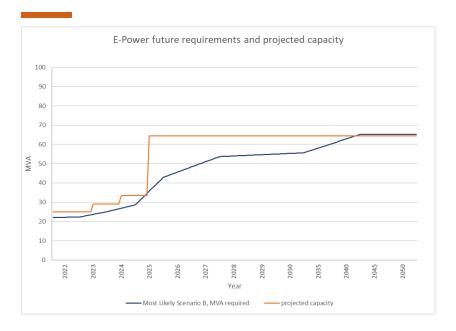
Risk of not enough connection capacity available (congestion, bays are not available)

	year	options	CAPEX
short	2023	Lower redundancy (Temporary until 2025)	100-150 k€
term	2024	Statcom	1,25 M€
	2024	WKO	1,5 M€ (tbc)
long term	2025	Option 4A: Ypenburg	40 M€
		OPEX	1,4 M€/year
			Ca. 43 M€

Mos	t likely Scenario A		20	22			20	23		2024			2025				
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Option Lower redundancy (termporary)																	
Opt	Option Statcom																
1	basic engineering option Statcom																
2	equipment sizing, incl. specification																
3	main equipment purchase / reservation																
4	detailed engineering																
5	construction																
6	testing & commissioning																
Opt	ion WKO																
1	basic engineering and grondonderzoek																
2	Permitting process																
3	realisation																
Opt	ion 4A																
1	basic engineering option 4A DSM part																
2	permitting & licence																
3	equipment sizing																
4	main equipment purchase / reservation																
5	detailed engineering																
6	construction																
7	testing & commissioning																



Most Likely Scenario B



Risks:

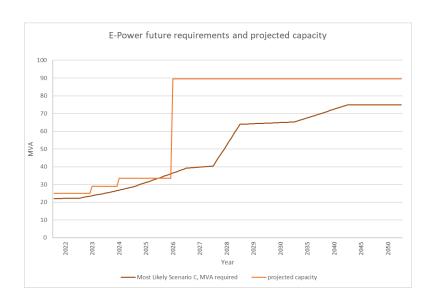
Risk of not enough connection capacity available (congestion, bays are not available)

	year	options	CAPEX
short	2023	Lower redundancy (Temporary until 2025)	100-150 k€
term	2024	Statcom	1,25 M€
	2024	WKO	1,5 M€ (tbc)
long term	2025	Option 4A: Ypenburg	40 M€
		OPEX	1,4 M€/year
			Ca. 43 M€

Mos	t likely Scenario B		20	22			20	23		2024			2025				
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Option Lower redundancy (termporary)																	
Opti	on Statcom																
1	basic engineering option Statcom																
2	equipment sizing, incl. specification																
3	main equipment purchase / reservation																
4	detailed engineering																
5	construction																
6	testing & commissioning																
Opti	on WKO																
1	basic engineering and grondonderzoek																
2	Permitting process																
3	realisation																
Opti	on 4A																
1	basic engineering option 4A DSM part																
2	permitting & licence																
3	equipment sizing																
4	main equipment purchase / reservation																
5	detailed engineering																
6	construction																
7	testing & commissioning																



Most Likely Scenario C



Risks:

- Implementation time

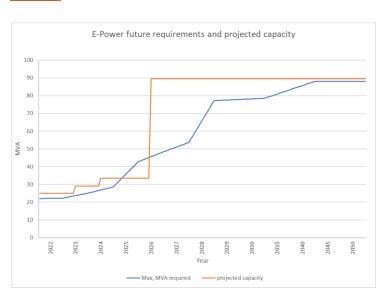


	year	options	CAPEX
short term	2023	Lower redundancy (temporary)	100-150k€
	2024	Statcom	1,25 M€
	2024	WKO	1,5 M€ (tbc)
longterm	-	Option 7: Wateringen	59 M€
		OPEX	2,25 M€/year
			62.046

ca. 62 M€

Most likely Scenario C		2022					20)23			20	24		2025				2026			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Option Lower redundancy (termporary)					•					•		•		•		•					
Opt	ion Statcom																				
1	basic engineering option Statcom																				П
2	equipment sizing, incl. specification																				Г
3	main equipment purchase / reservation																				
4	detailed engineering																				
5	construction																				П
6	testing & commissioning																				Г
Opt	on WKO															-					
1	basic engineering and grondonderzoek																				Г
2	Permitting process																				Г
3	realisation																				Г
Opt	ion 7																				
1	basic engineering option 7A DSM part																				Г
2	permitting & licence																				П
3	equipment sizing																				П
4	main equipment purchase / reservation																				П
5	detailed engineering																				
6	construction																				
7	testing & commissioning			Γ																	

Maximum Scenario



Risks:

- Implementation time
- Risk of too little capacity for new partner (2025-2026)



	year	options	CAPEX
short	2023	Lower redundancy (temporary)	100-150k€
term	2024	Statcom	1,25 M€
	2024	WKO	1,5 M€ (tbc)
longterm	-	Option 7: Wateringen	59 M€
		OPEX	2,25 M€/year
	_		ca. 62 M€

Max Scenario		2022			2023				2024				2025				2026			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Option Lower redundancy (termporary)					-				-		-			•		-				
Option Statcom																				
1 basic engineering option Statcom																				
2 equipment sizing, incl. specification																				
3 main equipment purchase / reservation																				
4 detailed engineering																				
5 construction																				
6 testing & commissioning																				
Option WKO																				
1 basic engineering and grondonderzoek																				
2 Permitting process																				
3 realisation																				
Option 7																				
1 basic engineering option 7A DSM part																				
2 permitting & licence																				
3 equipment sizing																				
4 main equipment purchase / reservation																				
5 detailed engineering																				
6 construction																				
7 testing & commissioning																				