HITACHI
Inspire the Next

HVDC is a key enabler for a carbon-neutral energy system. It is highly efficient for transmitting large amounts of electricity over long distances, integration of renewables and interconnecting grids.

HVDC Classic Reference list

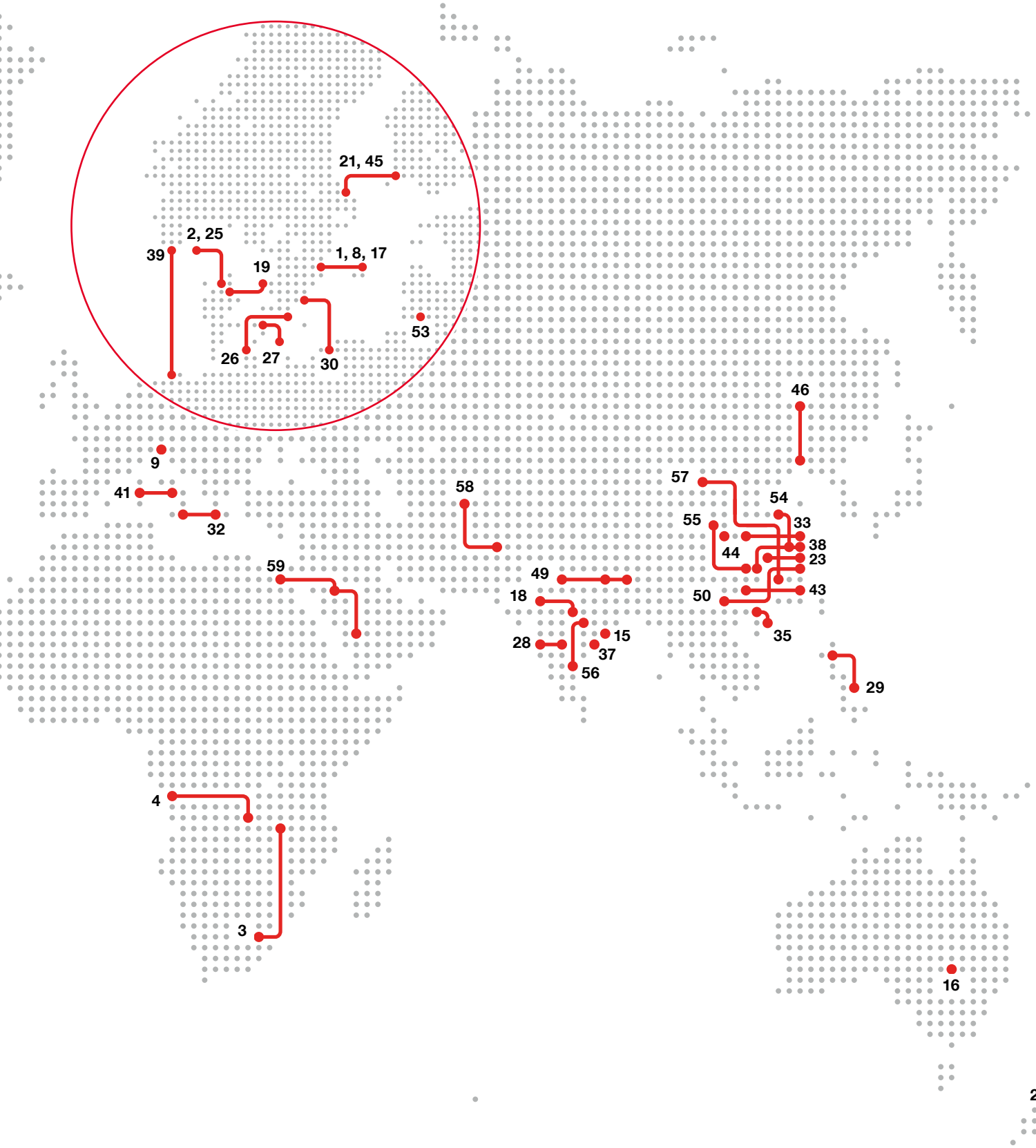
Thyristor valve projects

Hitachi Energy

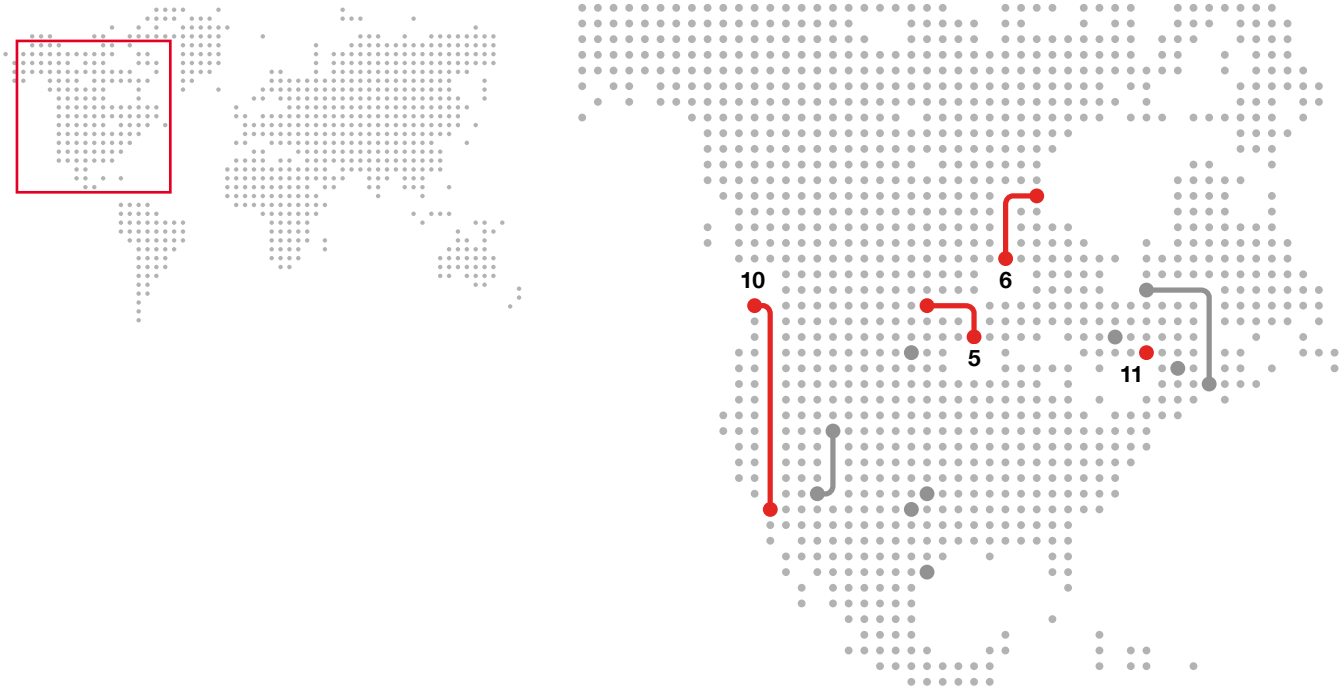
HVDC Classic
Projects worldwide

Part of the world

For more information about the projects visit: hitachienergy.com/hvdc



North America

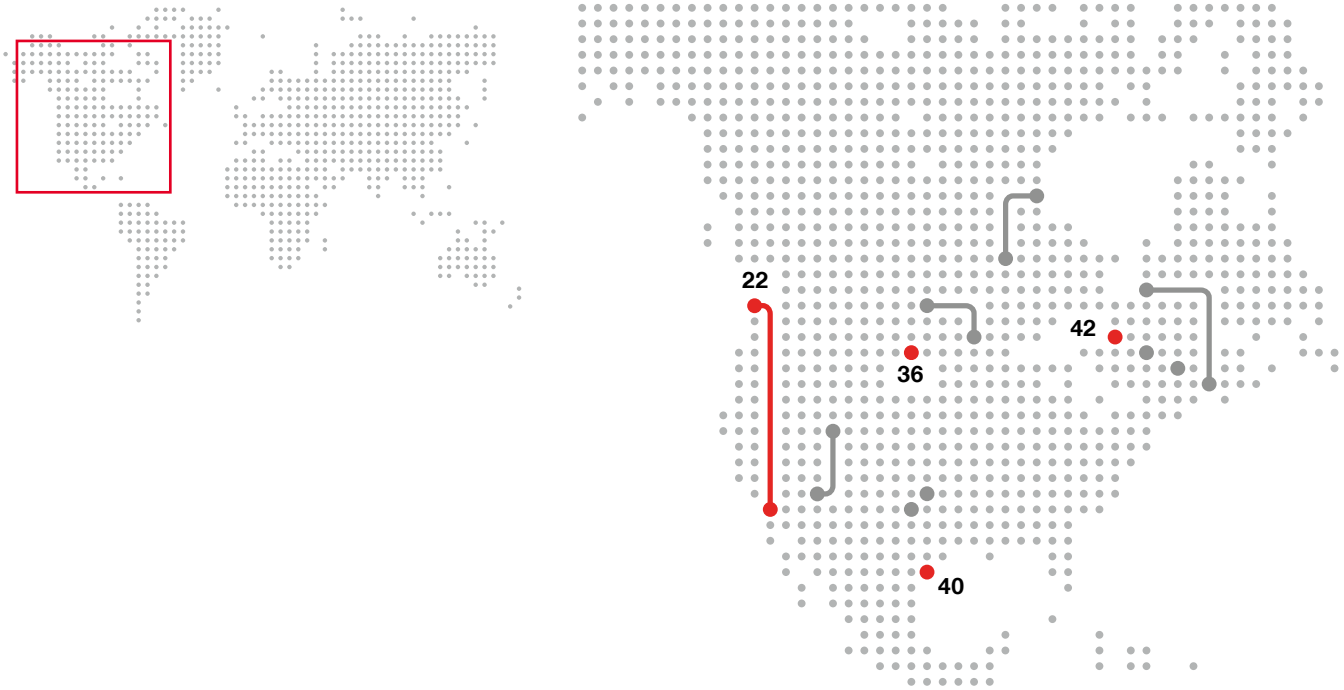


Scheme	5. CU-Project	6. Nelson River 2	10. Pacific Intertie	11. Châteauguay
Commissioning year	1979	1978-1985	1970	1984
Owner/Original customer/Country	CPA, USA and UPA, USA	Manitoba Hydro, Canada	Bonneville Power Administration, USA and The Department of Water and Power of the City of Los Angeles, USA	Hydro-Quebec, Quebec, Canada
Power Transmitted, MW	1000	2000	1440	2 x 500
Direct voltage, kV	±400	±500	±400	-
Converter station location and AC grid voltage	Coal Creek, 235 kV Dickinson, 350 kV	Henday, 230 kV Dorsey, 230 kV	Celilo, 230 kV Sylmar, 230 kV	Hydro-Quebec side, 315 kV U.S. side, 120 kV
Length of overhead DC line, km	687 km	940 km	1360 km	Back-to-back
Cable route length, km	-	-	-	-
Main reason for choosing HVDC system	Connecting remote generation, Environment, Stability benefits	Interconnecting grids, Connecting remote generation	Connecting remote generation Stability benefits	Interconnecting grids

North America

Scheme	12. Intermountain	13. Highgate	14. Blackwater	20. Quebec-New England
Commissioning year	1986	1985	1985	1990-1992
Owner/Original customer/Country	Intermountain Power Agency, USA. Agent: The Department of Water and Power of the City Los Angeles, USA	Vermont Electric Power Company Inc., USA	Public Service Company of New Mexico, USA	Hydro Quebec, Quebec, Canada and New England Hydro Transmission Electric Company Inc., USA
Power Transmitted, MW	1920	200	200	2000 (Multi-terminal)
Direct voltage, kV	±500	-	-	±450
Converter station location and AC grid voltage	Intermountain, 345 kV Adelanto, 500 kV	Highgate North, 120 kV Highgate South, 115 kV	New Mexico side, 345 kV Texas side, 230 kV	Radisson, 315 kV Sandy Pond, 345 kV Nicolet, 230 kV
Length of overhead DC line, km	785 km	Back-to-back	Back-to-back	1480 km
Cable route length, km	-	-	-	-
Main reason for choosing HVDC system	Connecting remote generation	Interconnecting grids	Interconnecting grids	Connecting remote generati-on, Interconnecting grids

North America

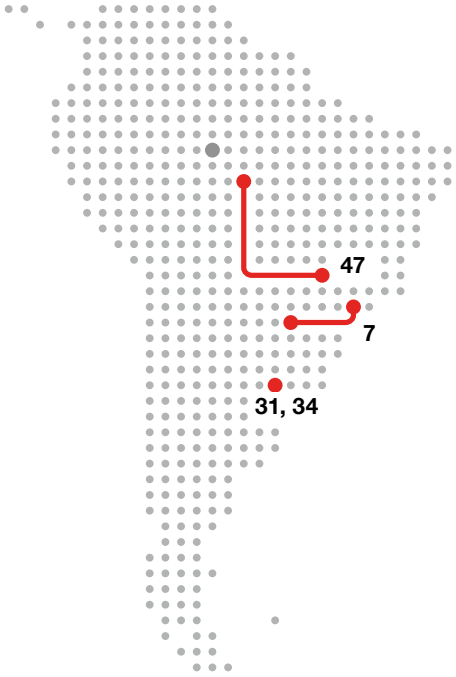


Scheme	22. Pacific Intertie Expansion	36. Rapid City	40. Sharyland	42. Outaouais
Commissioning year	1989	2003	2007	2009
Owner/Original customer/Country	Bonneville Power Administration, USA and The Department of Water and Power of the City of Los Angeles, USA	Basin Electric Power Cooperative and Black Hills Power & Light, USA	Sharyland Utilities, USA	Hydro Quebec, Quebec, Canada
Power Transmitted, MW	1100	2 x 100	150	2 x 625
Direct voltage, kV	±500	-	-	-
Converter station location and AC grid voltage	Celilo, 500 kV Sylmar, 230 kV	Rapid City, South Dakota, USA, 230 kV both sides	Mission, Texas, USA, 138 kV both sides	Outaouais, Quebec side, 315 kV Ontario side, 240 kV
Length of overhead DC line, km	1360 km	Back-to-back	Back-to-back	Back-to-back
Cable route length, km	-	-	-	-
Main reason for choosing HVDC system	Connecting remote generation, Interconnecting grids, Rapid control	Interconnecting grids	Interconnecting grids, Trading	Interconnecting grids

North America

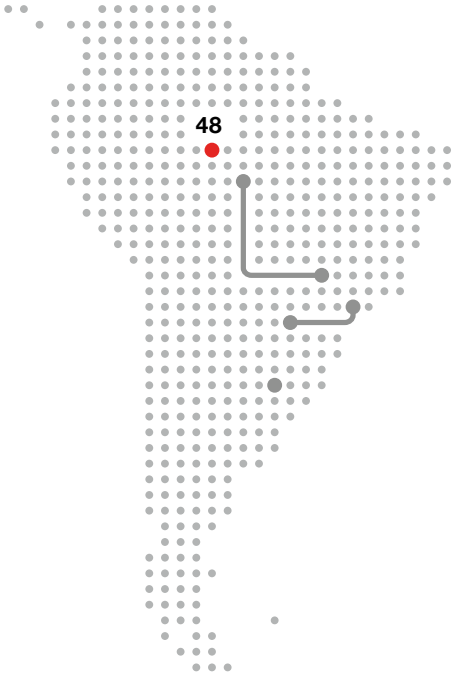
Scheme	51. Oklaunion	52. Railroad DC Tie
Commissioning year	2014	2014
Owner/Original customer/Country	American Electric Power (AEP), USA	Sharyland Utilities, USA
Power Transmitted, MW	220	150
Direct voltage, kV	-	-
Converter station location and AC grid voltage	Oklaunion, 345 kV	Mission, Texas, USA, 138 kV both sides
Length of overhead DC line, km	Back-to-back	Back-to-back
Cable route length, km	-	-
Main reason for choosing HVDC system	Interconnecting grids	Interconnecting grids

South America



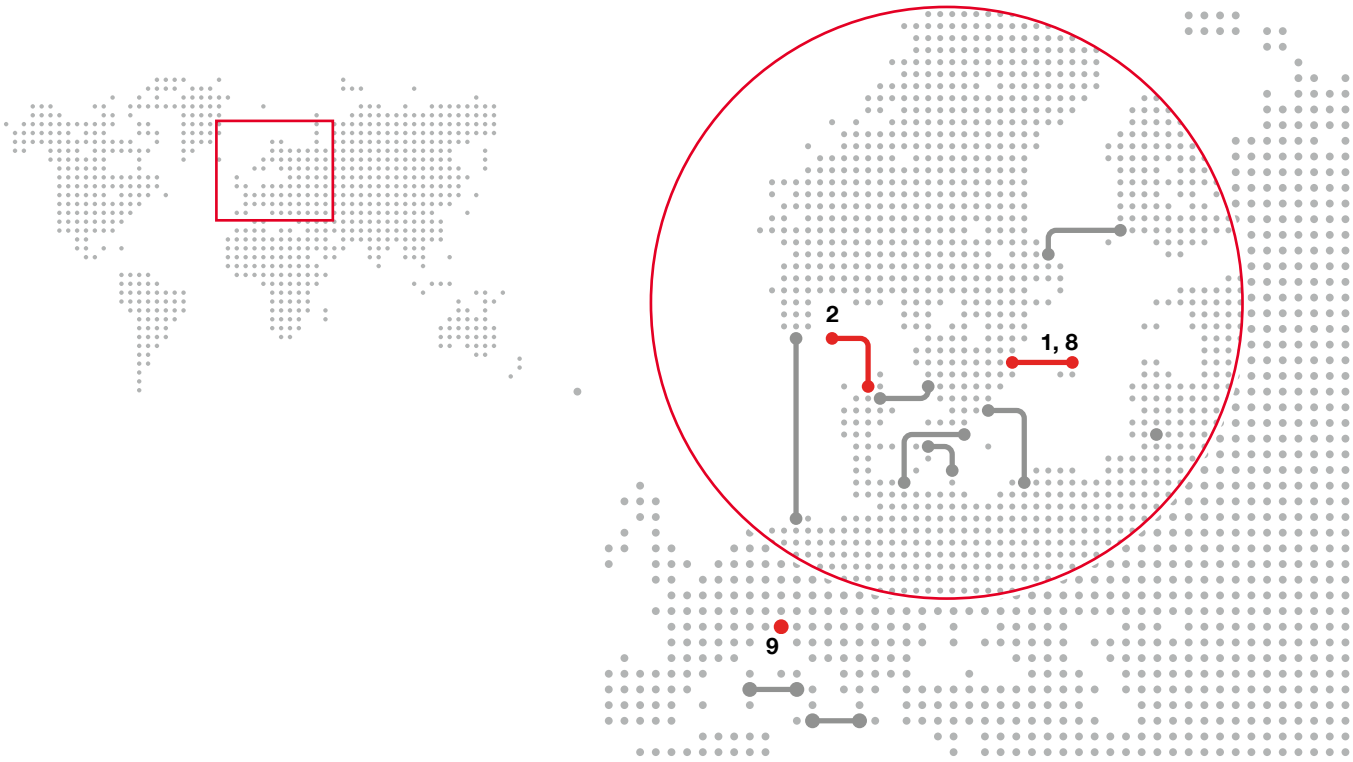
Scheme	7. Itaipu	31. Brazil-Argentina Interconnection 1	34. Brazil-Argentina Interconnection 2	47. Rio Madeira
Commissioning year	1984-1990	2000	2002	2012
Owner/Original customer/Country	Furnas, Brazil	CIEN a company of the Endesa Group, Chile	CIEN a company of the Endesa Group, Chile	Eletronorte, Brazil
Power Transmitted, MW	3150 + 3150	2 x 550	2 x 550	3150
Direct voltage, kV	±600	-	-	±600
Converter station location and AC grid voltage	Foz do Iguaçu, 500 kV Ibiuna, 345 kV	Garabi, Brazil, 525 kV Argentina, 500 kV	Garabi, Brazil, 525 kV Argentina, 500 kV	Port Velho, Rondonia Araraquara, Sau Paulo 500 kV
Length of overhead DC line, km	785 and 805 km, respectively	Back-to-back	Back-to-back	2500 km
Cable route length, km	-	-	-	-
Main reason for choosing HVDC system	Interconnecting grids, Connecting remote generation	Interconnecting grids	Interconnecting grids	Connecting remote generation

South America



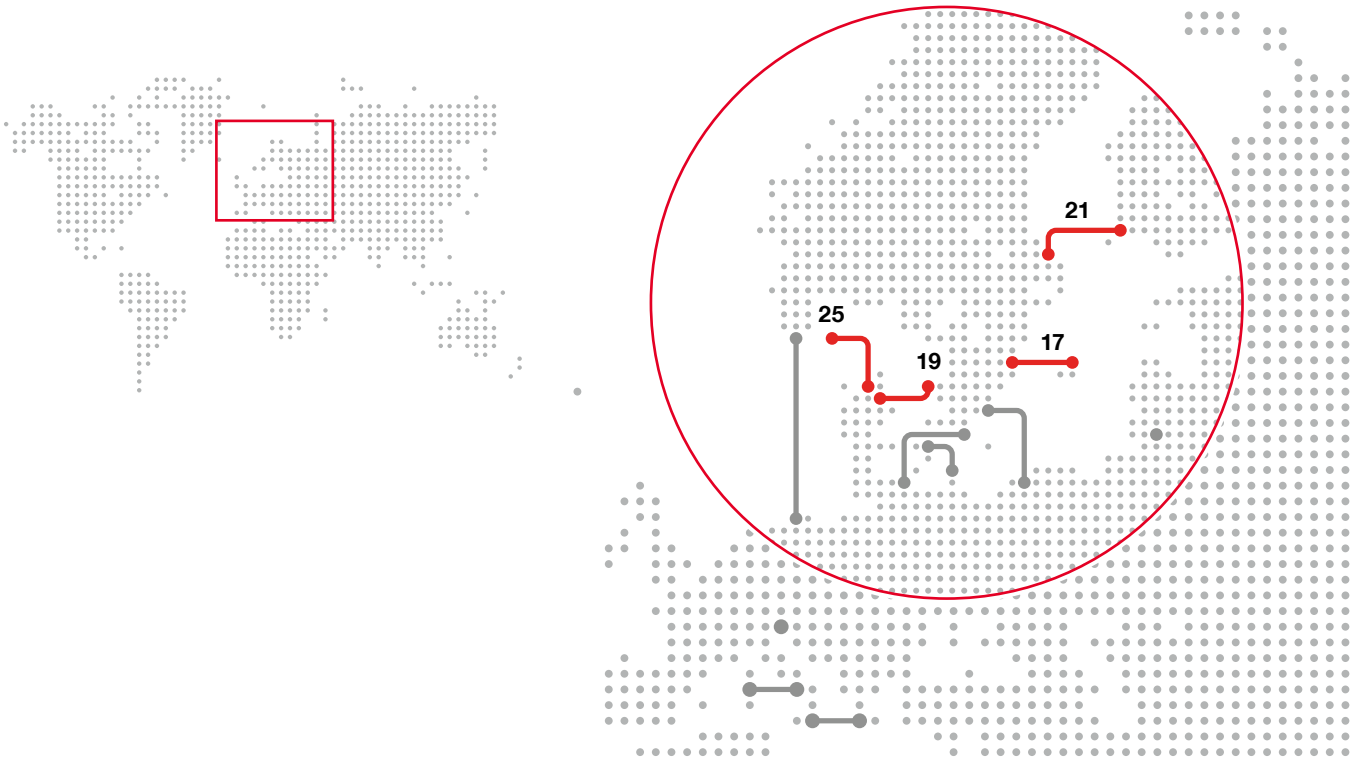
Scheme	48. Rio Madeira Back-to-back
Commissioning year	2013
Owner/Original customer/Country	Eletrosul, Brazil
Power Transmitted, MW	2 x 400
Direct voltage, kV	-
Converter station location and AC grid voltage	Port Velho, Rondonia 500 kV/230 kV
Length of overhead DC line, km	Back-to-back
Cable route length, km	-
Main reason for choosing HVDC system	Interconnecting grids

Europe



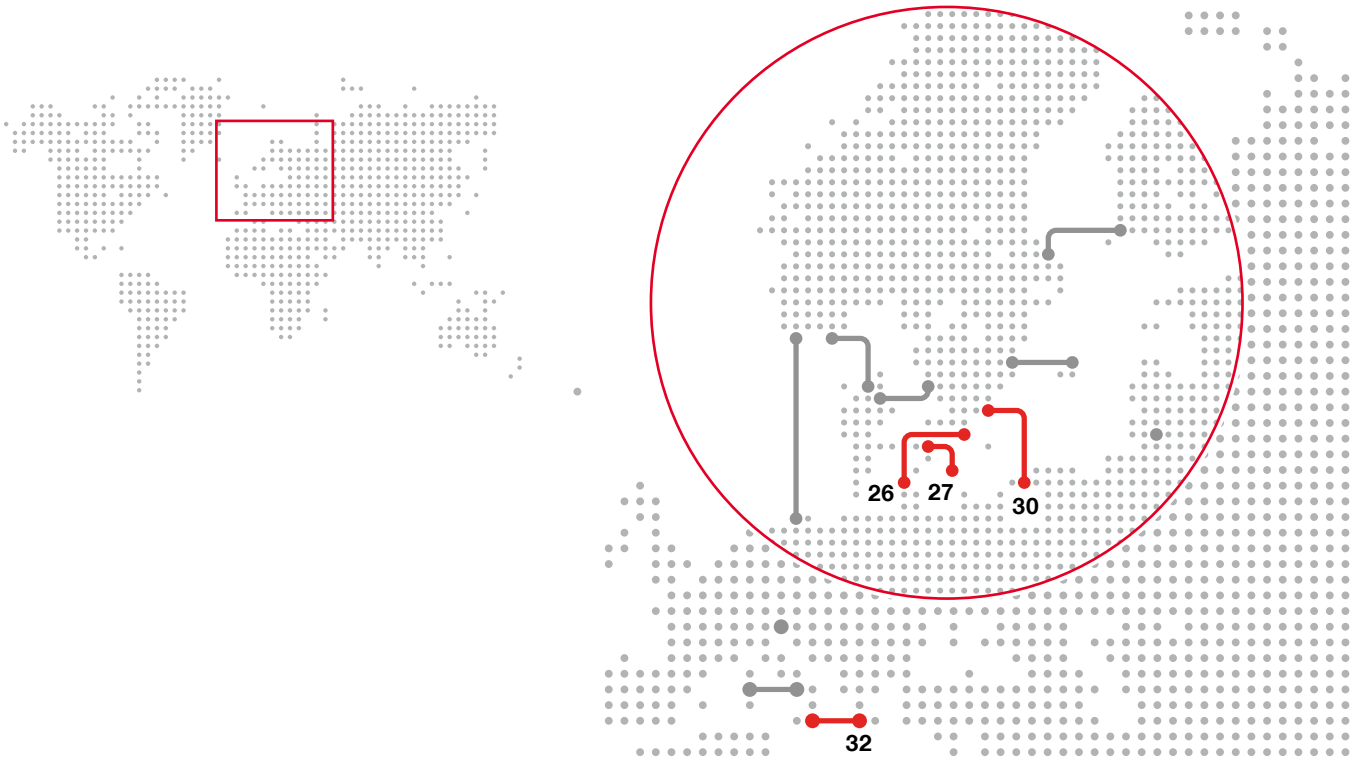
Scheme	1. Gotland	2. Skagerrak 1 & 2	8. Gotland 2	9. Dürnrohr
Commissioning year	1970	1976-1977	1983	1983
Owner/Original customer/Country	Statens Vattenfallsverk, Sweden	Statkraft, Norway and Elsam, Denmark	Statens Vattenfallsverk, Sweden	Österreichische Elektrizi-tats-wirtschafts AG, Austria
Power Transmitted, MW	(20) + 10	500	130	550
Direct voltage, kV	(100) + 50	±250	150	-
Converter station location and AC grid voltage	Västervik, 130 kV Visby, 70 kV	Kristiansand, 275 kV Tjele, 150 kV	Västervik, 130 kV Visby, 70 kV	Dürnrohr, 420 kV both sides
Length of overhead DC line, km	-	113 km	7 km	Back-to-back
Cable route length, km	96 km	127 km	96 km	-
Main reason for choosing HVDC system	Interconnecting grids, Island connection, Long sea cros-sing, frequency control	Interconnecting grids, Sea crossing	Interconnecting grids, Island connection, Long sea crossing, frequency control	Interconnecting grids

Europe



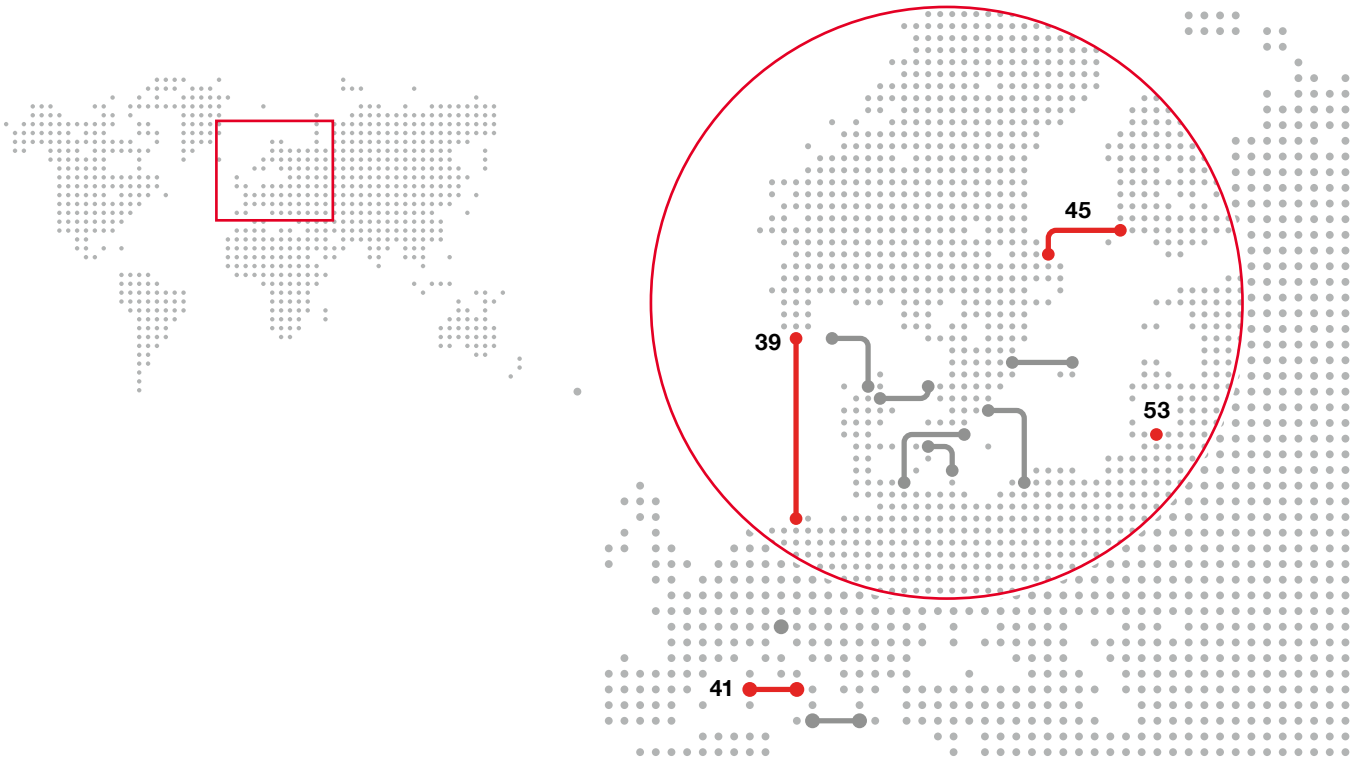
Scheme	17. Gotland 3	19. Konti-Skan 2	21. Fenno-Skan	25. Skagerrak 3
Commissioning year	1987	1988	1989	1993
Owner/Original customer/Country	Statens Vattenfallsverk, Sweden	Statens Vattenfallsverk, Sweden and Elsam, Denmark	Statens Vattenfallsverk, Sweden and Imatran Voima Oy, Finland	Statnett, Norway and Elsam, Denmark
Power Transmitted, MW	130	300	500	440
Direct voltage, kV	150	285	400	350
Converter station location and AC grid voltage	Västervik, 130 kV Visby, 70 kV	Lindome, 130 kV Vester Hassing, 400 kV	Dannebo, 400 kV Rauma, 400 kV	Kristiansand, 300 kV Tjele, 400 kV
Length of overhead DC line, km	7 km	61 km	33 km	113 km
Cable route length, km	96 km	88 km	200 km	127 km
Main reason for choosing HVDC system	Interconnecting grids, Island connection, Long sea crossing	Interconnecting grids, Sea crossing	Interconnecting grids, Sea crossing	Interconnecting grids, Sea crossing

Europe



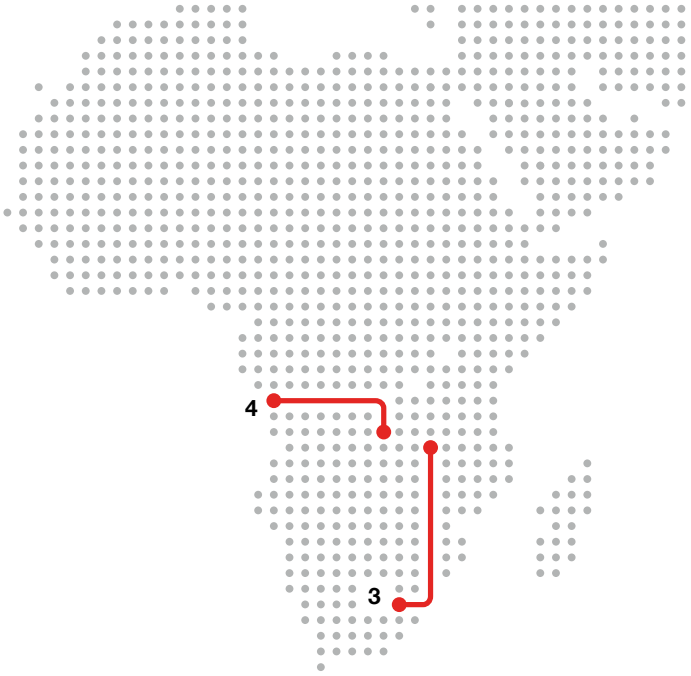
Scheme	26. Baltic Cable	27. Kontek	30. SwePol	32. Italy-Greece
Commissioning year	1994	1995	2000	2001
Owner/Original customer/Country	Baltic Cable AB, Sweden	Elkraft, Denmark VEAG, Germany	SwePol Link AB, Sweden	ENEL, Italy and PPC, Greece
Power Transmitted, MW	600	600	600	500
Direct voltage, kV	450	400	450	400
Converter station location and AC grid voltage	Kruseberg, 400 kV Herrenwyk, 380 kV	Bjæverskov, 400 kV Bentwisch, 400 kV	Stärnö, 400 kV Slupsk, 400 kV	Galatina, 400 kV Arachthos, 400 kV
Length of overhead DC line, km	12 km	-	-	110 km
Cable route length, km	261 km	170 km (120 km under ground)	230 km	200 km (40 km + 160 km)
Main reason for choosing HVDC system	Interconnecting grids, Sea crossing	Interconnecting grids, Sea crossing	Interconnecting grids, Sea crossing	Interconnecting grids, Sea crossing

Europe



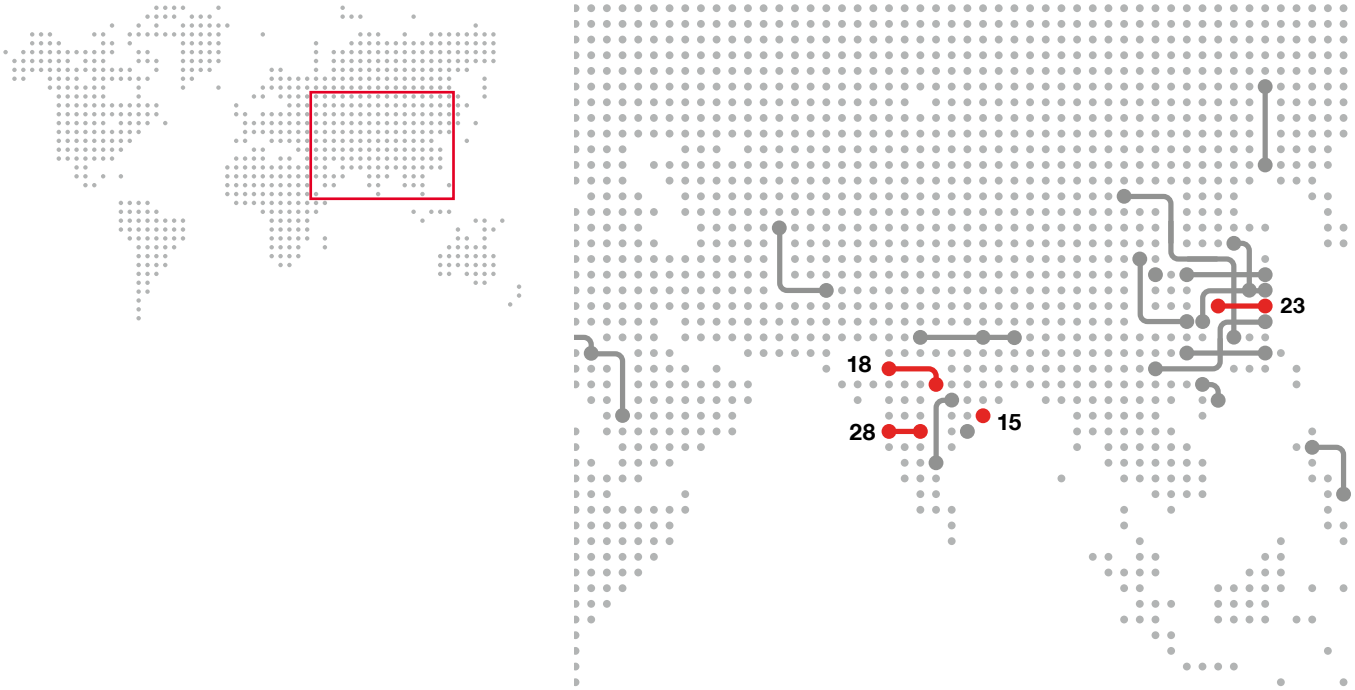
Scheme	39. Norned	41. SAPEI	45. Fenno-Skan 2	53. LitPol
Commissioning year	2008	2011	2011	2015
Owner/Original customer/Country	Statnett, Norway TenneT, The Netherlands	Terna, Italy	Fingrid, Finland and Svenska Kraftnät, Sweden	Litgrid AB, Lithuania
Power Transmitted, MW	700	1000	800	500
Direct voltage, kV	±450	±500	500	-
Converter station location and AC grid voltage	Eemshaven, 400 kV Feda, 300 kV	Fiume Santo, 400 kV Latina, 400 kV	Finnböle, 400 kV Rauma, 400 kV	Lithuanian side, 330 kV Polish side, 400 kV
Length of overhead DC line, km	-	-	70 km (Swedish side) 33 km(Finnish side)	Back-to-back
Cable route length, km	560 km	420 km (sea) + 15 km (land)	200 km	-
Main reason for choosing HVDC system	Interconnecting grids, Sea crossing, Trading	Interconnecting grids, Sea crossing	Interconnecting grids, Sea crossing	Interconnecting grids

Africa



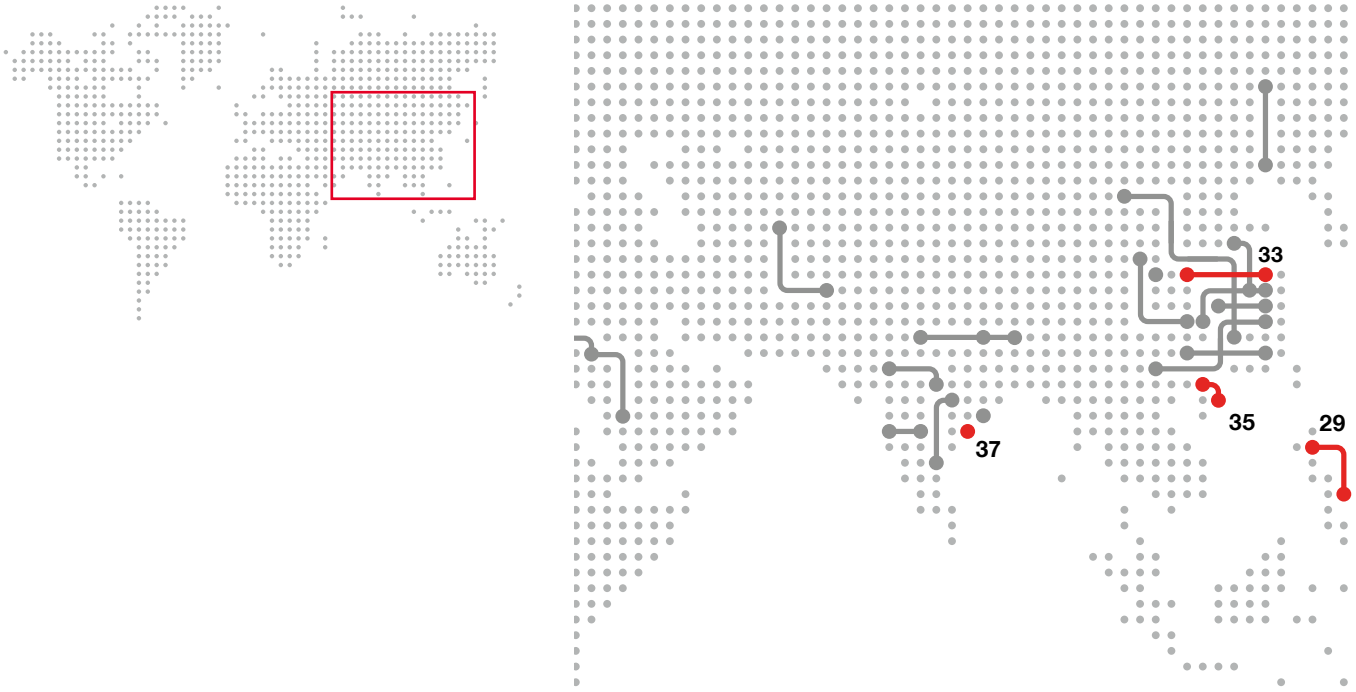
Scheme	3. Cahora Bassa	4. Inga-Kolwezi
Commissioning year	1977-1979	1982
Owner/Original customer/Country	Hidroelectrica de Cahora Bassa, Mocambique and Electricity Supply Commission, South Africa	SNEL, DR Congo
Power Transmitted, MW	1930	560
Direct voltage, kV	±533	±500
Converter station location and AC grid voltage	Songo, 220 kV Apollo, 275 kV	Inga (Zaire River), 220 kV Kolwezi (Shaba), 220 kV
Length of overhead DC line, km	1420 km	1700 km
Cable route length, km	-	-
Main reason for choosing HVDC system	Connecting remote generation, Interconnecting grids	Connecting remote generation, Interconnecting grids

Asia



Scheme	15. Vindhyachal	18. Rihand-Delhi	23. Gezhouba-Shanghai	28. Chandrapur-Padghe
Commissioning year	1989	1990	1989	1999
Owner/Original customer/Country	National Thermal Power Corporation, India	National Thermal Power Corporation, India	Central China Electric Power Administration, China and East China Electric Power Administration, China	Maharashtra State Electricity Board, India
Power Transmitted, MW	2 x 250	1500	1200	1500
Direct voltage, kV	-	±500	±500	±500
Converter station location and AC grid voltage	Northern system, 400 kV Western system, 400 kV	Rihand, 400 kV Dadri, 400 kV	Gezhouba, 500 kV Nan Qiao, 230 kV	Chandrapur, 400 kV Padghe, 400 kV
Length of overhead DC line, km	Back-to-back	814 km	1000 km	736 km
Cable route length, km	-	-	-	-
Main reason for choosing HVDC system	Connecting remote generation	Connecting remote generation, Stability	Connecting remote generation, Interconnecting grids, Stability benefits	Connecting remote generation, Stability benefits

Asia

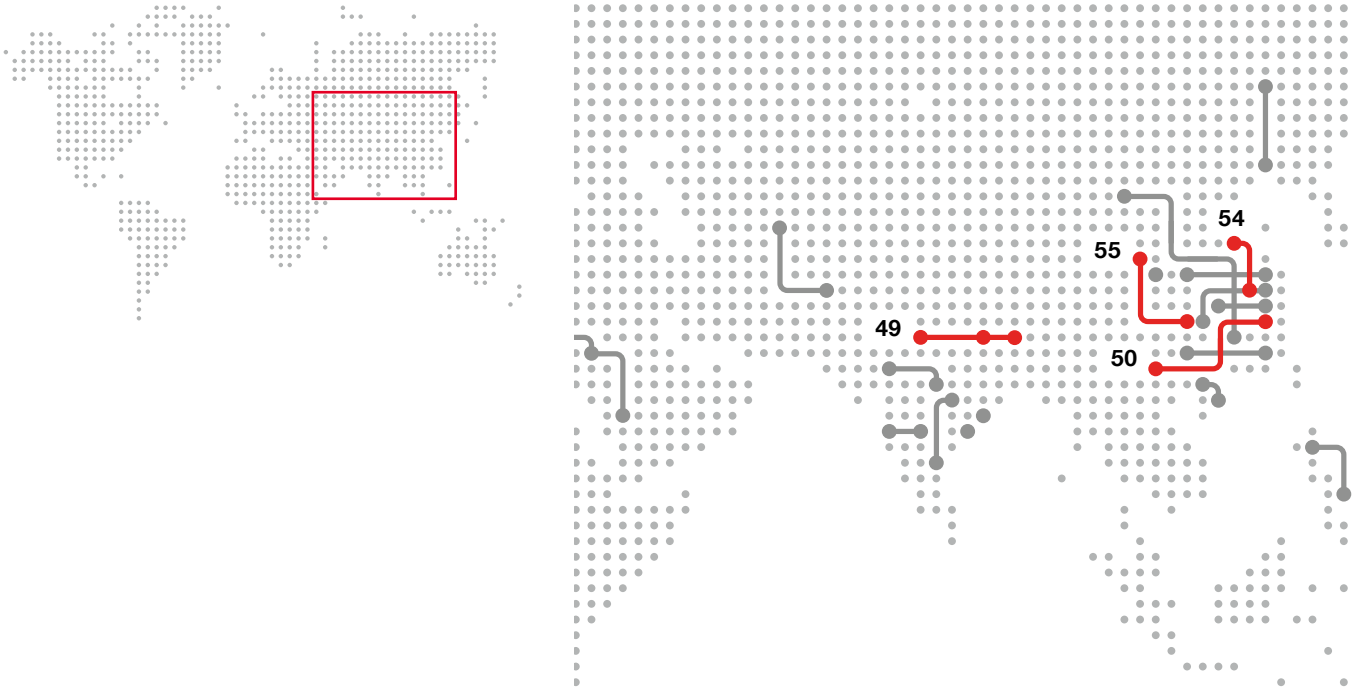


Scheme	29. Leyte-Luzon	33. Three Gorges-Changzhou	35. Three Gorges-Guangdong	37. Vizag II
Commissioning year	1998	2003	2004	2005
Owner/Original customer/Country	National Power Corporation, Manila, Philippines	China Power Grid Development Co Ltd, China	State Power Corporation of China, China	Powergrid Corporation of India Ltd. India
Power Transmitted, MW	440	3000	3000	500
Direct voltage, kV	350	±500	±500	-
Converter station location and AC grid voltage	Ormoc, 230 kV, Naga, 230 kV	Longquan, 500 kV Zhengping, 500 kV	Jingzhou, 500 kV Huizhou, 500 kV	Visakhapatnam, India, 400 kV both sides
Length of overhead DC line, km	433 km	890 km	940 km	Back-to-back
Cable route length, km	19 km	-	-	-
Main reason for choosing HVDC system	Interconnecting grids, Sea crossing	Connecting remote generation	Connecting remote generation	Interconnecting grids

Asia

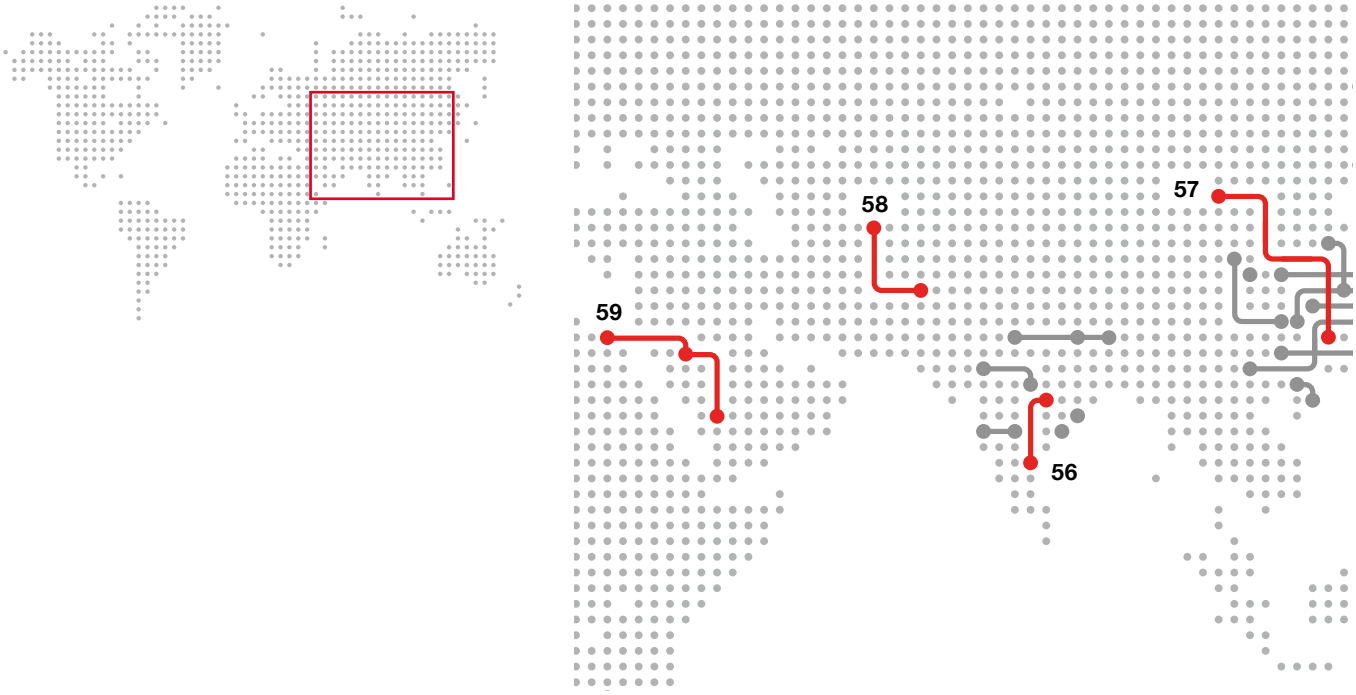
Scheme	38. Three Gorges-Shanghai	43. Xiangjiaba-Shanghai	44. Lingbao II Extension Project	46. Hulunbeir-Liaoning
Commissioning year	2006	2010	2010	2010
Owner/Original customer/Country	State Grid Corporation of China, China	State Grid Corporation of China ,China	State Grid Corporation of China, China	State Grid Corporation of China, China
Power Transmitted, MW	3000	6400	750	3000
Direct voltage, kV	±500	±800	-	±500
Converter station location and AC grid voltage	Yidu, 500 kV Huaxin, 500 kV	Fulong: 525 kV Fengxian: 515 kV	Huazhong: 500 kV Xibei: 330 kV	Yimin: 500 kV Mujia: 500 kV
Length of overhead DC line, km	1059 km	2071 km	Back-to-back	920 km
Cable route length, km	-	-	-	-
Main reason for choosing HVDC system	Connecting remote generation	Connecting remote generation	Interconnecting grids	Connecting remote generation, Interconnecting grids

Asia



Scheme	49. North-East Agra	50. Jinping-Sunan	54. Jinbei-Nanjing	55. Jiuquan-Hunan
Commissioning year	2017	2013	2017	2017
Owner/Original customer/Country	Power Grid Corporation of India Ltd. India	State Grid Corporation of China, China	State Grid Corporation of China (SGCC)	State Grid Corporation of China (SGCC)
Power Transmitted, MW	6000 (Multi-terminal) 4 x 2000 (Converters)	7200	8000	8000
Direct voltage, kV	±800	±800	±800	±800
Converter station location and AC grid voltage	Biswanath Chariali: 400 kV Alipurduar: 400 kV Agra: 400 kV	Yulong: 535 kV Tongli: 505 kV	Jinbei: 500 kV Nanjin: 500 kV	Jinquanbei: 750 kV Hunan: 500 kV
Length of overhead DC line, km	1728 km	2090 km	1118 km	2390 km
Cable route length, km	-	-	-	-
Main reason for choosing HVDC system	Connecting remote generation, Interconnecting grids	Connecting remote generation	Connecting remote generation, Interconnecting grids	Connecting remote generation, Interconnecting grids

Asia



Scheme	56. Raigarah - Pugalur	57. Changji-Guquan	58. CASA1000	59. Saudi-Egypt
Commissioning year	2017-2019	2017-2018	2021	2026
Owner/Original customer/Country	Power Grid Corporation of India Ltd.	State Grid Corporation of China (SGCC)	Barki Tojik, Tajikistan and NTDC, Pakistan	Saudi Electricity Company (SEC), Saudi Arabia and Egyptian Electricity Transmission Company (EETC), Egypt
Power Transmitted, MW	6000	12000	1300	3000 Madinah and Badr: 3000 MW each Tabuk: 1500 MW
Direct voltage, kV	±800	±1100	±500	±500
Converter station location and AC grid voltage	Raigarh 400 kV Pugalur 400 kV	Changji Guquan	Nowshera: 500 kV Sangtuda: 500 kV	Madinah: 380 kV Tabuk: 380 kV Badr: 500 kV
Length of overhead DC line, km	1830 km	3000 km	800 km	1300
Cable route length, km	-	-	-	1250
Main reason for choosing HVDC system	Connecting remote generation	Connecting remote generation, Interconnecting grids	Interconnecting grids	Interconnecting grids

Australia and Oceania

Scheme	16. Broken hill	24. New Zealand Inter-Island HVDC
Commissioning year	1986	1991-1992
Owner/Original customer/Country	Southern Power Corporation, Australia	Trans Power New Zealand Ltd., New Zealand
Power Transmitted, MW	40	560
Direct voltage, kV	-	-350
Converter station location and AC grid voltage	Broken Hill 22 kV and 6.9 kV	Benmore, 220 kV Haywards, 220 kV
Length of overhead DC line, km	Back-to-back	575 km
Cable route length, km	-	42 km
Main reason for choosing HVDC system	Interconnecting grids, Frequency control	Interconnecting grids, Sea crossing

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