

Supplementary Information

Network Theory Integrated Life Cycle Assessment for an Electric Power System, *Sustainability* 2015, 7, 10961-10975

Heetae Kim and Petter Holme *

Department of Energy Science, Sungkyunkwan University, 440-746 Suwon, Korea;

E-Mail: heetae.kim@skku.edu

* Author to whom correspondence should be addressed; E-Mail: holme@skku.edu;
Tel.: +82-31-299-6273; Fax: +82-31-299-4279.

Academic Editor: Yasuhiro Fukushima

Received: 9 March 2015 / Accepted: 3 August 2015 / Published: 11 August 2015

We construct a network model for the Chilean electricity power grid [1,2]. The details of the system boundary are described in Table S1.

1. Regions in the System Boundary in Chile

Table S1. The details of regions of the system boundary.

Region	Province	Consumption (GWh)	Number of Substations	Distributed load (GWh)	Load for a substation (GWh)
Atacama		3140	34	3140	92.35
	Huasco	807	11	807	73.39
	Copiapó	2027	19	2027	106.67
	Chañaral	306	4	306	76.50
Coquimbo		2119	24	2119	88.29
	Choapa	263	9	263	29.24
	Elqui	1342	9	1342	149.10
	Limarí	514	6	514	85.67
Valparaíso		4655	29	4655	160.52
	Los Andes	287	4	413	103.33
	Petorca	202	2	266	132.84
	Quillota	533	8	786	98.24
	San Antonio	404	4	531	132.64
	San Felipe	407	2	470	235.18
	Valparaíso	1905	9	2189	243.24
	Isla de Pascua	16	0	-	
	Marga Marga	901	0	-	

Table S1. Cont.

Region	Province	Consumption (GWh)	Number of Substations	Distributed load (GWh)	Load for a substation (GWh)
Santiago Metropolitan		16,521	46	16,521	359.15
	Chacabuco	474	3	474	157.85
	Cordillera	1479	8	1479	184.91
	Maipo	1098	9	1098	122.02
	Melipilla	422	10	422	42.20
	Santiago	12,365	13	12,365	951.16
	Talagante	683	2	683	341.43
Libertador General Bernardo O'Higgins		3830	31	3830	123.55
	Cachapoal	2690	20	2690	134.49
	Cardenal Caro	180	6	180	29.97
	Colchagua	960	5	960	192.08
Maule		2207	22	2207	100.32
	Cauquenes	127	2	127	63.37
	Curicó	616	9	616	68.49
	Linares	618	6	618	102.93
	Talca	846	5	846	169.25
Bío Bío		7145	56	7145	127.59
	Arauco	586	8	586	73.31
	Biobío	1381	13	1381	106.21
	Concepción	3480	29	3480	119.99
	Ñuble	1698	6	1698	283.02
La Araucanía		1580	14	1580	112.86
	Cautín	1230	9	1230	136.72
	Malleco	350	5	350	69.90
Los Ríos		580	10	580	58.00
	Ranco	148	1	148	147.59
	Valdivia	432	9	432	48.05
Los Lagos		1504	26	1504	57.85
	Chiloé	330	11	344	31.23
	Llanquihue	695	8	706	88.21
	Osorno	446	7	455	64.97
	Palena	33	0	-	
Total		43,281	292	43,281	1280.473174

2. The Network Construction Rules

We use raw data to construct the Chilean electricity network model from mainly two raw data sets, the statistics of the Chilean electricity power grid (CNE 2012) and the grid map (CDEC-SIC 2012). The statistics provide the details of the network connections, but do not provide information about location. The grid map illustrates the connection status between nodes without detailed descriptions. We fuse the two sets of raw data into one data set filling in the missing data or solving the contradictory data mismatches. The rules are as below.

Table S2. Data handling rules.

	Data handling rule
1	Ignore the diacritics to achieve compatibility with computer software: exchange á, ñ, ó, etc. into a, n, o, etc.
2	Allow minimum modification not to distort the raw information too much.
3	When the information from the statistics conflicts with the one from the grid map, we choose the statistics with reference.
4	When a node is divided into subunits such as ‘Node L1’ and ‘Node L2’ in the raw data, the subunits are considered as the same node, ‘Node’. In this case, the numbers of edges of the subunits are summed up.
5	When a node has too little information to realize, it is excluded.
6	When the same edge information overlaps, only one edge is constructed in the network.
7	When the same name is used for different nodes or connections, we differentiate them.
8	Some connections are manually generated based on the grid map. In this case, power plants are connected to the nearest substation.
9	When a long edge has a node on the edge, we divide the edge into two segments.

The handling details on the raw data are listed in Table S3.

Table S3. The details of data handling.

From	To	Rule
Nueva Ventanas	Ventanas	3
Ventanas	Nueva Ventanas	3
Aconcagua Sección 1	Aconcagua	4
Aconcagua Sección 2	Excluded	4
Nehuenco 1 no1—San Luis	Nehuenco 1—San Luis	4
Nehuenco 1 no2—San Luis	Excluded	4
Nehuenco 2 no1—San Luis	Nehuenco 2—San Luis	4
Nehuenco 2 no2—San Luis	Excluded	4
Tap EL Llano—Los Maquis	EL Llano—Los Maquis	3
Guacolda—Maitencillo L1	Guacolda—Maitencillo	4
Guacolda—Maitencillo L2	Excluded	4
Cardones—Planta Matta	Excluded	5
Maitencillo—Cardones L1	Excluded	4
Maitencillo—Cardones L2	Maitencillo—Cardones	4
Central Quintero—San Luis	Quintero—San Luis	3
Maria Dolores—Tap Infers	Maria Dolores—Inforsa	3
Tap Molinos—Molinos	Excluded	5
Pangue—Charrua (54.00km)	Excluded	6
Tap Zona de Caida—Zona de Caida	Excluded	5
Palmucho—Zona de Caida	Excluded	5
Charrua—Ancoa L1	Charrua—Ancoa	4

Table S3. Cont.

From	To	Rule
Charrua—Ancoa L2	Excluded	4
Alto Jahuel—Chena L1	Alto Jahuel—Chena	4
Alto Jahuel—Chena L2	Excluded	4
Antuco—Charrua 3	Excluded	5
Pangue—Tap Trupan (33.76km)	Excluded	6
Cruce Aéreo—Canal de Chacao	Punta Barranco—Punta San Gallan	3
Huasco—Maitencillo L1	Huasco—Maitencillo	4
Huasco—Maitencillo L2	Excluded	4
Diego de Almagro—El Salado	Diego de Almagro—El Salvador	3
San Vicente—Cementos Bio Bio	Excluded	5
ERBB—Petropower	Excluded	5
Tap Paine—Paine	Excluded	3
Miraflores—Marga Marga L1	Miraflores—Marga Marga	4
Miraflores—Marga Marga L2	Excluded	4
Pan de Azúcar—San Joaquín (7.38km)	Excluded	6
Alto Melipilla—Tap A Melipilla	Alto Melipilla—Tap Alto Melipilla	3
Punta de Cortes—Lo Miranda L1	Punta de Cortes—Lo Miranda	4
Punta de Cortes—Lo Miranda L2	Excluded	4
Alonso de Ribera—Ejercito L1	Alonso de Ribera—Ejercito	4
Alonso de Ribera—Ejercito L2	Excluded	4
Talcahuano—Latorre L1	Talcahuano—Latorre	4
Talcahuano—Latorre L2	Excluded	4
Latorre—Tumbes	Excluded	5
Villarrica—Pucon	Excluded	5
Maule—Lircay (0.37km)	Excluded	6
Estructura 103,Fatima	Excluded	5
Estructura 107—Estructura 118 L1	Excluded	5
Estructura 107—Estructura 118 L2	Excluded	5
Estructura 118,Estructura 119	Excluded	5
Estructura 129—Horcones L1	Excluded	5
Estructura 129—Horcones L2	Excluded	4
Estructura 29—Estructura 44 L1	Excluded	5
Estructura 29—Estructura 44 L2	Excluded	5
Estructura 61—Tap Lota L1	Excluded	5
Estructura 61—Tap Lota L2	Excluded	5
Estructura 74—Talca L1	Excluded	5
Estructura 74—Talca L2	Excluded	5
Estructura 92,Estructura 107	Excluded	5
Estructura No 23,Newen	Excluded	5
Los Angeles—pangue (7.10km)	Excluded	6
Tap Tuniche—Rancagua	Tuniche—Rancagua	3
Tap Colcura—Colura	Excluded	5
Central Rapel—Quelentaro	Rapel—Quelentaro	3
Central Rapel—Reguladora Rapel	Excluded	5
Reguladora Rapel—Marchigue	Rapel—Marchihue	3
Reguladora Rapel—Nihue	Rapel—Nihue	3

Table S3. *Cont.*

From	To	Rule
Portezuelo—Marchigue	Portezuelo—Marchihue	3
Marchigue—Alcones	Marchihue—Alcones	3
Paniahue—Marchigue	Paniahue—Marchihue	3
Tap Lota,Estructura 92 L1	Excluded	5
Tap Lota—Estructura 92 L2	Excluded	4
Portezuelo—La Esperanza	Portezuelo—Esperanza	3
Tap Cholacan—Cholacan	Excluded	5
Tap el Maiten—El Maiten	Excluded	5
Tap hualte—Hualte	Excluded	5
Barro Blanco—Purranque L1	Barro Blanco—Purranque	4
Barro Blanco—Purranque L1	Excluded	4
Purranque—Puerto Varas L1	Purranque—Puerto Varas	4
Purranque—Puerto Varas L2	Excluded	4
Rivadavia—Minera el Indio	Rivadavia—El Indio	3
Elevadora Canela 2—Las Palmas	Canela 2—Las Palmas	3
Capullo—Barro Blanco (20.50km)	Excluded	6
Carena—Puente Alto CMPC	Carena—Puente Alto	3
Tap Playa Ancha—Playa Ancha	Excluded	5
Tap Quilpue—Quilpue	Excluded	5
Tap Renaca—Renaca	Excluded	5
Tap San Felipe 110—San Felipe	Excluded	5
Tap Algarrobo—Casa Blanca	Excluded	5
Tap Quintay—Quintay	Excluded	5
Tap S. Sebastian—S. Sebastian	Excluded	5
FFCC Los Andes—Hnos Clark	Los Andes—Hnos Clark	3
Las Vegas—FFCC Los Andes	Las Vegas—Los Andes	3
Las Vegas—FFCC Rungue	Las Vegas—Rungue	3
San Pedro Antigua—FFCC San Pedro	Excluded	5
Tap San Felipe 44—San Felipe	Excluded	5
San Bernardo—Malloco	Excluded	5
Tap Punta Peuco—Cem Polpaico	Excluded	5
Tap A Cordova—A Cordova	Excluded	5
Tap Altamirano—Altamirano	Excluded	5
Tap Andes—Andes	Excluded	5
Tap Apoquindo—Apoquindo	Excluded	5
Tap Batuco—Batuco	Excluded	5
Tap Carrascal—Carrascal	Excluded	5
Tap Club Hipico—Club Hipico	Excluded	5
Tap Chacabuco—Chacabuco	Excluded	5
Tap L Dominicos—L Dominicos	Excluded	5
Tap La Cisterna—La Cisterna	Excluded	5
Tap La Dehesa—La Dehesa	Excluded	5
Tap La Pintana—La Pintana	Excluded	5
Tap La Reina—La Reina	Excluded	5
Tap Las Acacias—Las Acacias	Excluded	5
Tap Lo Boza—Lo Boza	Excluded	5
Tap Lo Valledor—Lo Valledor	Excluded	5

Table S3. Cont.

From	To	Rule
Tap Macul—Macul	Excluded	5
Tap Maipú—Maipú	Excluded	5
Tap Pajaritos—Pajaritos	Excluded	5
Tap Pudahuel—Pudahuel	Excluded	5
Tap Quilicura—Quilicura	Excluded	5
Tap Recoleta—Recoleta	Excluded	5
Tap San Bernardo—San Bernardo	Excluded	5
Tap San Joaquín—San Joaquín	Excluded	5
Tap San José—San José	Excluded	5
Tap San Pablo—Lo Aguirre	Excluded	5
Tap San Pablo—San Pablo	Excluded	5
Tap Santa Elena—Santa Elena	Excluded	5
Tap Santa Marta—Santa Marta	Excluded	5
Tap Santa Raquel—Santa Raquel	Excluded	5
Tap Santa Rosa—Santa Rosa	Excluded	5
Tap Vitacura—Vitacura	Excluded	5
Lo Prado—Curacaví	Excluded	5
Tap Rungue—Rungue	Excluded	5
Torre 125—Caleu	Excluded	5
Tap F Chagres,F Chagres	Excluded	5
San Vicente,Estructura No 23	Excluded	5
Salamanca,Estructura 170	Excluded	5
Estructura 2 (Los Lirios)—Cerrillos	Excluded	5
Diego de Almagro—Tal Tal	Segmented	9
Maitencillo—Cardones	Segmented	9
Las Companias—Maitecillo	Segmented	9
Pan de Assumer—Las Companias	Segmented	9
Pan de Assumer—Guyana	Segmented	9
Las Palmas—Pan de Assumer	Segmented	9
Los Molles—Ovalle	Segmented	9
Ovalle—Illapel	Segmented	9
Los Olivos—Choapa	Los Vilos—Choapa	3
Laguna Verde—San Antonio	Segmented	9
Rancagua—Paine	Segmented	9
Tap Los Bajos—Queltehues	Segmented	9
Punta de Cortes—Tuniche	Excluded	3
Alto Jahuel—Tinguiririca	Segmented	9
Rapel—Cerro Navia	Segmented	9
San Fernando—Curico	Segmented	9
Hualane—Los Maquis	Excluded	3
Cipreses—Utah	Segmented	9
Los Angeles—Santa Fe	Excluded	3
Charrua—Ralco	Segmented	9
Tap Lota—Lota	Excluded	3
Horcones—Lebu	Segmented	9

Table S3. Cont.

From	To	Rule
Victoria—Angol	Segmented	9
Angol—Los Angeles	Segmented	9
Temuco—Charrua	Segmented	9
Los Lagos—Valdivia	Segmented	9
Los Lagos—La Union	Segmented	9
Purranque—Puerto Varas	Segmented	9
Chonchi—Quellon	Segmented	9
Cautin—Valdivia	Segmented	9
Temuco—Loncoche	Segmented	9
Licanco—Imperial	Excluded	3
Las Lajuelas—Santa Elisa	Excluded	3
Tap Tres Bocas—Corral	Excluded	3
Tap Quilmo—Quilmo	Excluded	3
Quilmo—Recinto	Excluded	3
Tap el Manzano—El Totoral	Excluded	3
Tap Escuadron—Escuadron	Excluded	3
Tap Placeres—Placeres	Excluded	3
Cerro Navia—Polpaico	Segmented	9
Cerro Navia—Las Vegas	Segmented	9
Tres_Esquinas—Bulnes	Excluded	3
Tap_Valparaiso—Valparaiso	Excluded	3

The new edges are generated based on the grid map as Table S4.

Table S4. Newly generated edges based on the grid map.

End 1	End 2	Voltage	Length (km)	The number of lines
Central_Taltal	Paposo	220	3	1
Chanaral	Diego_de_Almagro	66	72	1
Central_Salvador	Diego_de_Almagro	220	5	1
Central_Diego_de_Almagro	Diego_de_Almagro	220	5	1
El_Salvador	Tap_Potrerillos	110	14.41	2
Tap_Potrerillos	Diego_de_Almagro	110	14.41	2
Tap_Potrerillos	Potrerillos	110	28.82	2
Carrera_Pinto	Minera_Mantos_de_Oro	220	90	1
Cardones	Central_Tierra_Amarilla	220	20	1
Cardones	La_Candelaria	220	50	1
Cardones	Termopacifico	220	20	1
Cardones	Cerrillos	110	20	1
Cardones	Tap_Castilla	110	44.2	1
Tap_Castilla	Tap_Los_Colorados	110	44.2	1
Tap_Los_Colorados	Maitencillo	110	44.2	1
Tap_Castilla	Castilla	110	8	1
Tap_Los_Colorados	Los_Colorados	110	8	1
Huasco	Tap_Pellets	110	4	2
Tap_Pellets	Maitencillo	110	30	2
Pellets	Tap_Pellets	110	10	2

Table S4. *Cont.*

End 1	End 2	Voltage	Length (km)	The number of lines
Pan_de_Azucar	Tap_Las_Companias	110	30	1
Tap_Las_Companias	Las_Companias	110	5	1
Tap_Las_Companias	Tap_Romeral	110	5	1
Tap_Romeral	Tap_Incahuasi	110	65	1
Tap_Incahuasi	Tap_Pajonales	110	5	1
Tap_Pajonales	Tap_Dos_Amigos	110	5	1
Tap_Dos_Amigos	Tap_Algarrobo	110	60	1
Tap_Algarrobo	Maitencillo	110	40	1
Tap_Romeral	Romeral	110	10	1
Tap_Incahuasi	Icahuasi	110	5	1
Tap_Pajonales	Pajonales	110	5	1
Tap_Dos_Amigos	Dos_Amigos	110	8	1
Tap_Algarrobo	Algarrobo	110	5	1
Maitencillo	Refugio	110	100	1
Maitencillo	Magnetita	110	110	1
Maitencillo	Paipote	110	100	1
Central_Punta_Colorada	Punta_Colorada	110	20	1
Puclaro	Marquesa	110	10	1
San_Juan	Pan_de_Azucar	66	4	2
El_Penon	Las_Piedras	110	30	1
Las_Palmas	Monte_Redondo	220	100	2
Monte_Redondo	Pan_de_Azucar	220	54.22	2
Monte_Redondo	Central_Monte_Redondo	110	10	1
Los_Molles	Tap_Monte_Patria	66	36.8	2
Tap_Monte_Patria	Ovalle	66	30	2
Tap_Monte_Patria	Monte_Patria	66	5	2
Monte_Patria	Central_Monte_Patria	110	5	1
Ovalle	Tap_Punitaqui	66	35	1
Tap_Punitaqui	Tap_El_Sauce	66	25	1
Tap_El_Sauce	Combarbala	66	10	1
Combarbala	Illapel	66	70.84	1
Tap_Punitaqui	Punitaqui	66	5	1
Punitaqui	Central_Punitaqui	66	5	1
Tap_El_Sauce	El_Sauce	66	5	1
Olivos	Los_Vilos	110	5	1
Los_Pelambres	Quillota	220	170	2
San_Isidro	San_Luis	110	30	1
Laguna_Verde	Tan_Casa_Blanca	66	28	2
Tan_Casa_Blanca	San_Antonio	66	30	2
Tan_Casa_Blanca	Casa_Blanca	66	30	1
Los_Vientos	Las_Vegas	110	10	1
Chacabuquito	Las_Vegas	110	30	1
Aconcagua	Tap_Los_Maquis	110	40	2
Tap_Los_Maquis	Las_Vegas	110	40	2
El_Llano	Polpaico	220	65	1

Table S4. Cont.

End 1	End 2	Voltage	Length (km)	The number of lines
Los_Maitenes	Disputada	220	25	1
Disputada	Alfalfal	220	50	2
Tap_Renca	San_Cristobal	110	40	2
Tap_Renca	Tap_La_Laja	110	10	2
Tap_La_Laja	Alto_Jahuel	110	30	2
Tap_Renca	Alfalfal	220	50	2
Tap_Renca	Alto_Jahuel	220	80	2
Tap_La_Laja	Tap_Maitenes	110	20	2
Tap_Maitenes	Tap_Los_Morros	110	30	2
Tap_Los_Morros	Tap_Guayacan	110	10	2
Tap_Guayacan	Tap_Puntilla	110	10	2
Tap_Puntilla	Tap_Caemsa	110	10	2
Tap_Caemsa	Tap_Los_Bajos	110	10	2
Tap_Los_Bajos	Queltehues	110	10	2
El_Volcan	Queltehues	110	20	1
Tap_Maitenes	Maitenes	110	10	2
Tap_Los_Morros	Los_Morros	110	10	1
Tap_Guayacan	Guayacan	110	10	1
Tap_Puntilla	Puntilla	110	10	1
Tap_Caemsa	Caemsa	110	10	1
Tap_Los_Bajos	Los_Bajos	110	10	1
Central_Candelaria	Candelaria	220	1	1
Chacayes	Interconexion	500	5	2
Interconexion	Minero	110	30	2
Interconexion	Sauzal	110	20	2
Interconexion	Sewel	66	25	2
Sewel	Coya	66	20	2
Pangal	Coya	66	30	2
ENOR	Sauzal	110	5	1
Sauzalito	Sauzal	110	10	1
Sauzal	Candelaria	110	40	1
Rancagua	Paine	66	10	1
Tap_Graneros	San_Fco_Mostazal	66	10	1
San_Fco_Mostazal	Hospital	66	10	1
Hospital	Paine	66	10	1
Rancagua	Tap_Los_Lirios	66	10	1
Tap_Los_Lirios	Cachapoal	66	10	1
Cachapoal	Chumaquito	66	10	1
Chumaquito	Rosario	66	10	1
Rosario	Tap_Rengo	66	10	1
Tap_Rengo	Pelequen	66	10	1
Pelequen	San_Fernando	66	10	1
Tap_Los_Lirios	Los_Lirios	66	10	1
Chumaquito	Tilcoco	66	15	1
Alto_Jahuel	Tap_Tuniche	154	30	2

Table S4. *Cont.*

End 1	End 2	Voltage	Length (km)	The number of lines
Tap_Tuniche	Tinguiririca	154	80	2
Tap_Tuniche	Rancagua	154	10	1
Rapel	Melipilla	220	57.51	2
Bajo_Melipilla	Cerro_Navia	220	60	2
Bajo_Melipilla	Tap_Mandinga	66	17.78	1
Tap_Mandinga	Las_Aranas	66	15	1
Tap_Mandinga	Mandinga	66	3	1
Las_Aranas	Rapel	66	30	1
San_Fernando	Nancagua	66	18.2	1
Nancagua	Paniahue	66	18	1
San_Fernando	Quinta	66	23.08	1
Quinta	Curico	66	30	1
Itahue	Tap_Agua_Negras	154	10	1
Tap_Agua_Negras	Tinguiririca	154	63.43	1
Agua_Negras	Tap_Agua_Negras	154	8	1
Central_Licanten	Licanten	110	3	1
Hualane	V_PRAT	66	15	1
V_PRAT	Tap_San_Rafael	66	15	1
Talca	Tap_San_Rafael	66	20	2
Tap_San_Rafael	Itahue	66	22.37	2
Pehuenche	Tap_Loma_Alta	220	4.5	1
Tap_Loma_Alta	Ancoa	220	20	1
Cipreses	Itahue	154	111.2	1
Cipreses	Tap_Curillinke	154	10	1
Tap_Curillinke	Itahue	154	101.2	1
Tap_Curillinke	Curillinke	154	3	1
Lircay	Talca	66	5	1
Lircay	San_Javier	66	15	1
San_Javier	Linares	66	29	1
Vinales	Constitucion	110	1	1
Celco	Constitucion	110	1	1
Quilleco	Tap_Trupan	110	1	1
Cholguan	Yungay	110	5	1
Central_Laja	Laja	110	5	1
Charrua	Palmucho	220	100	2
Palmucho	Ralco	220	31	2
Tome	Cocharcas	66	5	1
Cocharcas	Bellavista	66	5	1
Bellavista	Tap_Penco	66	5	1
Tap_Penco	Concepcion	66	10	1
Tap_Penco	Penco	66	5	1
Hauchipato	San_Vicente	66	10	2
Petroquimicas	San_Vicente	66	2	1
Petropower	Petroquimicas	110	10	1
Hualpen	Petrox	66	20	2

Table S4. *Cont.*

End 1	End 2	Voltage	Length (km)	The number of lines
FPC	Loma_Colorada	110	5	1
Tap_Loma_Colorada	Tap_Petrox	66	5	2
Tap_Petrox	Concepcion	66	15	2
Tap_Loma_Colorada	Coronel	66	5	2
Coronel	Central_Coronel	66	3	1
Coronel	Quilacoya	66	15	1
Coronel	Lota	66	5	1
Coronel	Enacar	66	8	1
Lota	Horcones	66	2	1
Arauco	Horcones	110	3	1
Horcones	Carampangue	66	15	1
Carampangue	Curanilahue	66	30	1
Curanilahue	Tres_Pinos	66	5	1
Tres_Pinos	Lebu	66	27.26	1
Victoria	Collipulli	66	30.11	1
Collipulli	Angol	66	30.11	1
Los_Angeles	Negrete	66	29.47	1
Negrete	Angol	66	20	1
Temuco	El_Rosal	220	100	1
El_Rosal	Charrua	220	95.7	1
Temuco	Chivilcan	66	2	1
Lautaro	Tap_Lautaro	66	0.5	1
Temuco	Tap_Lautaro	66	30	1
Tap_Lautaro	Victoria	66	29	1
Cautin	Ciruelos	220	100.8	1
Valdivia	Ciruelos	220	49	1
Valdivia	Calle_Calle	220	15	1
Calle_Calle	Chumpullo	66	10	1
Calle_Calle	Cautin	220	139.8	1
Central_Calle_Calle	Calle_Calle	110	10	1
Temuco	Temuco_Sur	66	1.02	3
Temuco_Sur	Tap_Pitrufulquen	66	40	3
Tap_Pitrufulquen	Loncoche	66	40	3
Tap_Pitrufulquen	Pitrufulquen	66	10	1
Antilhue	Valdivia	110	10	1
Los_Lagos	Tap_Huellehue	66	30	1
Tap_Huellehue	Valdivia	66	18.42	1
Tap_Huellehue	Huellehue	66	5	1
Los_Lagos	Paillaco	66	11.25	1
Paillaco	Pichirropulli	66	3.75	1
Pichirropulli	La_Union	66	22.5	1
Melipulli	Picarte	66	220	1
Pilmaiquen	Tap_Los_Negros	66	8.5	2
Tap_Los_Negros	Osorno	66	35	2
Tap_Los_Negros	Los_Negros	66	5	2

Table S4. Cont.

End 1	End 2	Voltage	Length (km)	The number of lines
Capullo	Antillanca	66	15	1
Antillanca	Barro_Blanco	66	40	1
Antillanca	Lican	66	10	1
Antillanca	Rio_Bonito	66	40	1
Rio_Bonito	Nalas	110	5	1
Rio_Bonito	Callao	110	8	1
Purranque	Frutillar	66	30	2
Frutillar	Puerto_Varas	66	17.13	2
Barro_Blanco	Chuyaca	110	10	1
Puerto_Montt	Barro_Blanco	220	100	1
Barro_Blanco	Valdivia	220	116.82	1
Puerto_Montt	Valdivia	220	216.82	1
Trapen	Los_Molinos	110	5	1
Colaco	Melipulli	110	70	1
Castro	Achao	66	70	1
Tap_Queilen	Puqueldon	66	60	1
Tap_Queilen	Queilen	66	110	1
Chonchi	Tap_Queilen	110	5	1
Tap_Queilen	Quellon	110	53.29	1
Quellon_2	Quellon	110	5	1
Central_Chiloe	Quellon	110	5	1
El_Penon	Pan_de_Azucar	66	4	1
Cerro_Navia	Lampa	220	14.8	2
Lampa	Polpaico	220	15	2
Cerro_Navia	Punta_Peuco	110	40	1
Punta_Peuco	Las_Vegas	110	36.9	1

3. Edge lists

Table S5. Edges in the final network model.

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Abanico	Charrua	115.97	154	115.97	1
Achupallas	Concon	12.56	110	12.56	1
Aconcagua	Saladillo	16	66	8	2
Aconcagua	Tap_Los_Maquis	80	110	40	2
Agua_Negras	Tap_Agua_Negras	8	154	8	1
Agua_Santa	Laguna_Verde	32.48	110	16.24	2
Agua_Santa	Miraflores	12.96	110	6.48	2
Agua_Santa	Placilla	4.3	110	4.3	1
Alfalfal	Los_Almendros	88.4	220	44.2	2
Alonso_de_Ribera	Perales	8.97	66	8.97	1
Alonso_de_Ribera	Ejercito	8.64	66	4.32	2
Alonso_de_Ribera	Chiguayante	15.75	66	15.75	1

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Alonso_de_Ribera	Penco	8.04	66	8.04	1
Alonso_de_Ribera	Andalien	0.08	66	0.08	1
Alto_Jahuel	Maipo	0.84	220	0.42	2
Alto_Jahuel	Polpaico	72	500	72	1
Alto_Jahuel	Chena	60.38	220	30.19	2
Alto_Jahuel	Cerro_Navia	78.4	220	39.2	2
Alto_Jahuel	Buin	5.55	66	5.55	1
Alto_Jahuel	Los_Almendros	81.4	220	40.7	2
Alto_Jahuel	Florida	48.86	110	24.43	2
Alto_Jahuel	Tap_Tuniche	60	154	30	2
Alto_Melipilla	Leyda	22.7	110	22.7	1
Ancoa	Polpaico	309.59	500	309.59	1
Ancoa	Alto_Jahuel	240.3	500	240.3	1
Ancoa	Itahue	130	220	65	2
Ancud	Chiloe	32.65	110	32.65	1
Antihue	Valdivia	10	110	10	1
Antillanca	Barro_Blanco	40	66	40	1
Antillanca	Lican	10	66	10	1
Antillanca	Rio_Bonito	40	66	40	1
Antuco	Charrua	135	220	67.5	2
Arauco	Central_Horcones	0.79	66	0.79	1
Arauco	Horcones	3	110	3	1
Arenas_Blancas	Puchoco	1.2	66	1.2	1
Bajo_Melipilla	El_Monte	23.42	66	23.42	1
Bajo_Melipilla	Cerro_Navia	120	220	60	2
Bajo_Melipilla	Tap_Mandinga	17.78	66	17.78	1
Barro_Blanco	Osorno	7.22	66	3.61	2
Barro_Blanco	Purranque	62.68	66	31.34	2
Barro_Blanco	Chuyaca	10	110	10	1
Barro_Blanco	Valdivia	116.82	220	116.82	1
Bellavista	Tap_Penco	5	66	5	1
Buin	Estructura_103	9.58	66	9.58	1
Buin	Paine	10.02	66	10.02	1
C_San_Fco_Mostazal	San_Fco_Mostazal	0.41	66	0.41	1
Cabrero	Masisa	0.3	66	0.3	1
Cachapoal	Machali	10.5	66	10.5	1
Cachapoal	Chumaquito	10	66	10	1
Calera_Centro	Cerro_Calera	1.3	66	1.3	1
Calle_Calle	Chumpullo	10	66	10	1
Valdivia	Cautin	149.8	220	149.8	1
Campanario	Charrua	2.9	154	2.9	1
Candelaria	Colbun	428.8	220	214.4	2
Candelaria	Minero	32.4	220	16.2	2
Canela	Las_Palmas	3.26	220	3.26	1

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Canutillar	Puerto_Montt	119.2	220	59.6	2
Capullo	Antillanca	15	66	15	1
Campangué	Curanilahue	30	66	30	1
Cardones	Carrera_Pinto	75.3	220	75.3	1
Cardones	Copiapo	13	110	13	1
Cardones	Tierra_Amarilla	16.24	110	16.24	1
Cardones	Medellin	0.4	220	0.4	1
Cardones	Central_Tierra_Amarilla	20	220	20	1
Cardones	La_Candelaria	50	220	50	1
Cardones	Termopacifico	20	220	20	1
Cardones	Cerrillos	20	110	20	1
Cardones	Tap_Castilla	44.2	110	44.2	1
Carena	Lo_Prado	20.4	44	10.2	2
Carena	Puente_Alto	40.44	44	40.44	1
Carrera_Pinto	Diego_de_Almagro	72.15	220	72.15	1
Carrera_Pinto	Minera_Mantos_de_Oro	90	220	90	1
Castro	Chonchi	17.89	110	17.89	1
Castro	Achao	70	66	70	1
Cauquenes	La_Vega	20.44	66	20.44	1
Cautin	Ciruelos	100.8	220	100.8	1
Celco	Constitucion	1	110	1	1
Cenizas	Cardones	20	110	20	1
Central_Calle_Calle	Calle_Calle	10	110	10	1
Central_Candelaria	Candelaria	1	220	1	1
Central_Chiloe	Quellon	5	110	5	1
Central_Constitucion	Constitucion	5.2	66	5.2	1
Central_Diego_de_Almagro	Diego_de_Almagro	5	220	5	1
Central_Laja	Laja	5	110	5	1
Central_Lautaro	Lautaro	0.8	66	0.8	1
Central_Licanten	Licanten	3	110	3	1
Central_Punta_Colorada	Punta_Colorada	20	110	20	1
Central_Salvador	Diego_de_Almagro	5	220	5	1
Central_Valdivia	Ciruelos	1.8	220	1.8	1
Cerrillos	Los_Loros	33.3	110	33.3	1
Cerro_Navia	Chena	23.52	110	11.76	2
Cerro_Navia	Nueva_Renca	9.54	110	4.77	2
Cerro_Navia	San_Cristobal	44.8	110	22.4	2
Cerro_Navia	Tap_San_Pablo	7.74	110	3.87	2
Cerro_Navia	Lampa	29.6	220	14.8	2
Cerro_Navia	Punta_Peuco	40	110	40	1
Chacabuquito	Las_Vegas	30	110	30	1
Chacayes	Interconexion	10	500	5	2

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Chagres	Los_Angeles	24.64	44	24.64	1
Chanaral	Diego_de_Almagro	72	66	72	1
Charrua	Santa_Lidia	0.8	220	0.8	1
Charrua	Maria_Dolores	35.9	220	35.9	1
Charrua	Cautin	204	220	204	1
Charrua	Ancoa	365.68	500	182.84	2
Charrua	Concepcion	143.6	220	71.8	2
Charrua	Hualpen	83.67	220	83.67	1
Charrua	Lagunillas	80	220	80	1
Charrua	Chillan	122.26	154	61.13	2
Charrua	Itahue	243.66	154	243.66	1
Charrua	Yungay	22.77	66	22.77	1
Charrua	Laja	47.35	66	47.35	1
Charrua	Los_Angeles	43.89	154	43.89	1
Charrua	Enlace	0.12	66	0.12	1
Charrua	Cabrero	10.37	66	10.37	1
Charrua	Palmucho	200	220	100	2
Chena	Lo_Espejo	2.92	110	1.46	2
Chiburgo	Colbun	3.2	66	3.2	1
San_Carlos	Parral	30	66	30	1
Chillan	San_Carlos	34.07	66	34.07	1
Chillan	Santa_Elvira	4.44	66	4.44	1
Chiloe	Pid_Pid	31.74	110	31.74	1
Chiloe	Degan	0.16	110	0.16	1
Choapa	Quereo	0.19	110	0.19	1
Choapa	Quinquimo	61.75	110	61.75	1
Cholguan	Yungay	5	110	5	1
Chomeco	Ancud	12.18	110	12.18	1
Chonchi	Tap_Queilen	5	110	5	1
Chumaquito	Rosario	10	66	10	1
Chumaquito	Tilcoco	15	66	15	1
Cipreses	Itahue	111.2	154	111.2	1
Cipreses	Tap_Curillinque	10	154	10	1
Cocharcas	Quirihue	56.7	33	56.7	1
Cocharcas	Bellavista	5	66	5	1
Colaco	Punta_Barranco	11.52	110	11.52	1
Colaco	Melipulli	70	110	70	1
Colbun	Machicura	7.4	220	7.4	1
Colbun	Procart	32.6	220	32.6	1
Collipulli	Angol	30.11	66	30.11	1
Colmito	Torquemada	0.7	110	0.7	1
Combarbala	Illapel	70.84	66	70.84	1
Concepcion	San_Vicente	21.8	154	10.9	2
Concepcion	Alonso_de_Ribera	0.07	154	0.07	1

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Concepcion	Mahns	23.42	66	23.42	1
Concepcion	Andalien	0.62	66	0.31	2
Concepcion	Estructura_28	8.86	66	4.43	2
Copiapo	Hernan_Fuentes	7.8	110	7.8	1
Coronel	Arenas_Blancas	2.59	66	2.59	1
Coronel	Bocamina	2.93	66	2.93	1
Coronel	Estructura_61	25.54	66	12.77	2
Coronel	Central_Coronel	3	66	3	1
Coronel	Quilacoya	15	66	15	1
Coronel	Lota	5	66	5	1
Coronel	Enacar	8	66	8	1
Curanilahue	Tres_Pinos	5	66	5	1
Diego_de_Almagro	El_Salvador	28.82	110	28.82	1
Disputada	Alfalfal	100	220	50	2
El_Eden	Alto_del_Carmen	40.9	110	40.9	1
El_Empalme	Calbuco	21.92	110	21.92	1
El_Empalme	Colaco	20.4	110	20.4	1
El_Llano	Los_Maquis	31.21	220	31.21	1
El_Llano	Polpaico	65	220	65	1
El_Melon	Tunel_El_Melon	8.8	44	8.8	1
El_Penon	Carmen_de_Andacollo	22.27	110	22.27	1
El_Penon	Andacollo	20.08	66	20.08	1
El_Penon	Las_Piedras	30	110	30	1
El_Penon	Pan_de_Azucar	4	66	4	1
El_Peumo	Santa_Rosa	11.74	66	11.74	1
El_Rosal	Charrua	95.7	220	95.7	1
El_Salto	Los_Almendros	35.18	110	17.59	2
El_Salto	San_Cristobal	22.86	110	11.43	2
El_Salvador	Tap_Potrerrillos	28.82	110	14.41	2
El_Toro	Antuco	35	220	17.5	2
Volcan	Queltehues	20	110	20	1
Emelda	Diego_de_Almagro	2.88	110	2.88	1
Enlace	Bucalemu	14	66	14	1
Escuadron	Loma_Colorada	5	110	5	1
Esperanza	Las_Vegas	0.27	110	0.27	1
Esperanza	Aconcagua	196.84	110	49.21	4
Esperanza	Calera_Centro	47.8	66	23.9	2
Estructura_129	Horcones	10.36	66	5.18	2
Estructura_44	Coronel	44.22	66	22.11	2
Estructura_74	Talca	8.76	66	4.38	2
Fatima	Hospital	6.88	66	6.88	1
Florida	Maitenes	62.6	110	31.3	2
Florida	Los_Almendros	0.84	110	0.84	1
Frutillar	Puerto_Varas	34.26	66	17.13	2

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Guacolda	Maitencillo	146.8	220	36.7	4
Huachipato	San_Vicente	20	66	10	2
Hernan_Fuentes	Tap_Impulsion	14.9	110	14.9	1
Horcones	Carampangue	15	66	15	1
Hospital	Paine	10	66	10	1
Hualane	Licanten	23	66	23	1
Hualane	Ranguili	14.5	66	14.5	1
Hualane	V_PRAT	15	66	15	1
Hualpen	San_Vicente	10.46	154	5.23	2
Hualpen	Lagunillas	24.13	154	24.13	1
Hualpen	Petrox	40	66	20	2
Huasco	Tap_Pellets	8	110	4	2
Illapel	Salamanca	25.4	110	25.4	1
Illapel	Choapa	49.82	110	49.82	1
Illapel	Ovalle	127.91	110	127.91	1
Interconexion	Minero	60	110	30	2
Interconexion	Sauzal	40	110	20	2
Interconexion	Sewel	50	66	25	2
Isla	Cipreses	6.6	154	3.3	2
Isla_de_Maipo	El_Monte	4.2	66	4.2	1
Itahue	Tinguiririca	73.43	154	73.43	1
Itahue	Curico	58.04	66	29.02	2
Itahue	Tap_Agua_Negras	10	154	10	1
La_Calera	El_Melon	23.46	44	11.73	2
La_Higuera	Tinguiririca	76	154	38	2
La_Higuera	La_Confluencia	36	154	18	2
La_Union	Picarte	58.69	66	58.69	1
Laguna_Verde	Tap_Casablanca	56	66	28	2
Lagunillas	Bocamina	5.8	220	5.8	1
Lagunillas	Coronel	3.76	154	3.76	1
Lampa	Polpaico	30	220	15	2
Las_Aranas	El_Peumo	5.4	66	5.4	1
Las_Aranas	Rapel	30	66	30	1
Las_Palmas	Totoral	0.21	220	0.21	1
Las_Palmas	Monte_Redondo	200	220	100	2
Las_Pinatas	Las_Balandras	11.4	66	5.7	2
Las_Vegas	Llay_Llay	6.4	110	6.4	1
Las_Vegas	Los_Andes	95.1	44	47.55	2
Las_Vegas	Rungue	50.14	44	25.07	2
Lautaro	Tap_Lautaro	0.5	66	0.5	1
Leyda	San_Antonio	15	110	15	1
Lican	Pilmaiquen	20.9	66	20.9	1
Linares	Ancoa	35.45	66	35.45	1
Linares	Parral	36.86	66	36.86	1

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Lircay	Mariposas	7	66	7	1
Lircay	Talca	5	66	5	1
Lircay	San_Javier	15	66	15	1
Lo_Aguirre	Lo_Prado	0.84	110	0.84	1
Lo_Espejo	Buin	41.76	110	20.88	2
Lo_Espejo	Ochagavia	14.68	110	7.34	2
Lo_Espejo	Panamericana	0.06	110	0.03	2
Lo_Miranda	Loreto	14.95	66	14.95	1
Lo_Prado	Cerro_Blanco	73.2	44	36.6	2
Loma_Colorada	Arenas_Blancas	17.1	66	17.1	1
Loma_los_Colorados	Punta_Peuco	21.37	110	21.37	1
Loncoche	Villarrica	37.68	66	37.68	1
Lord_Cochrane	Ochagavia	5.12	110	5.12	1
Los_Andes	Hnos_Clark	97.6	44	48.8	2
Los_Angeles	Pangue	80.4	66	80.4	1
Los_Angeles	El_Avellano	7.49	66	7.49	1
Los_Angeles	Duqueco	7.1	66	7.1	1
Los_Angeles	Negrete	29.47	66	29.47	1
Los_Espinos	Los_Vilos	7	220	7	1
Los_Lagos	Pullinque	128.42	66	64.21	2
Los_Lagos	Tap_Huellelhue	30	66	30	1
Los_Lagos	Paillaco	11.25	66	11.25	1
Los_Maitenes	Disputada	25	220	25	1
Los_Maquis	Polpaico	67.75	220	67.75	1
Los_Maquis	Hornitos	20.1	220	20.1	1
Los_Molinos	El_Empalme	14.81	110	14.81	1
Los_Molles	Tap_Monte_Patria	73.6	66	36.8	2
Los_Pelambres	Quillota	340	220	170	2
Los_Pinos	Charrua	0.7	220	0.7	1
Los_Quilos	Los_Maquis	0.2	110	0.2	1
Los_Quilos	Aconcagua	11	66	11	1
Los_Vientos	Las_Vegas	10	110	10	1
Los_Vilos	Las_Palmas	148.84	220	74.42	2
Los_Vilos	Choapa	0.15	110	0.15	1
Lota	Horcones	2	66	2	1
Maipo	Candelaria	92.8	220	46.4	2
Maitencillo	Agrosuper	0.2	220	0.2	1
Maitencillo	Cardones	399.03	220	133.01	3
Maitencillo	Vallenar	15.09	110	15.09	1
Maitencillo	Refugio	100	110	100	1
Maitencillo	Magnetita	110	110	110	1
Maitencillo	Paipote	100	110	100	1
Malloa	Tilcoco	13.6	66	13.6	1
Malloa_Nueva	Malloa	0.1	66	0.1	1

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Mampil	Rucue	26	220	26	1
Marchigue	Alcones	9.57	66	9.57	1
Maria_Dolores	Inforsa	37.3	220	37.3	1
Maria_Dolores	Laja	29.8	220	29.8	1
Maule	Lircay	26	66	26	1
Maule	Estructura_74	23.72	66	11.86	2
Melipulli	Los_Molinos	11.46	110	11.46	1
Melipulli	Picarte	220	66	220	1
Metro	Lord_Cochrane	0.06	110	0.03	2
Miraflores	Marga_Marga	4.98	110	2.49	2
Monte_Patria	Central_Monte_Patria	5	110	5	1
Monte_Redondo	Pan_de_Azucar	108.44	220	54.22	2
Monte_Redondo	Central_Monte_Redondo	10	110	10	1
Nancagua	Paniahue	18	66	18	1
Negrete	Angol	20	66	20	1
Nehuenco	San_Luis	1.46	220	0.73	2
Nihue	La_Manga	11.88	66	11.88	1
Nihue	Las_Aranas	15.24	66	15.24	1
Nogales	Los_Vilos	194.2	220	97.1	2
Nogales	Polpaico	147	220	73.5	2
Nueva_Ventanas	San_Pedro	60.3	110	30.15	2
Nueva_Ventanas	Torquemada	42.8	110	21.4	2
Nueva_Ventanas	GNL_Quintero	4.3	110	4.3	1
Nueva_Ventanas	Quintero	0.2	110	0.2	1
Ochagavia	Florida	34.26	110	17.13	2
Olivos	Los_Vilos	5	110	5	1
Osorno	La_Union	73.5	66	36.75	2
Ovalle	Tap_Punitaqui	35	66	35	1
Padre_las_Casas	Chivilcan	9.51	66	9.51	1
Paillaco	Pichirropulli	3.75	66	3.75	1
Paine	Isla_de_Maipo	22.3	66	22.3	1
Palmucho	Ralco	62	220	31	2
Pan_de_Azucar	Min_Carmen_de_Andacollo	46.2	220	46.2	1
Pan_de_Azucar	Punta_Colorada	176.08	220	88.04	2
Pan_de_Azucar	San_Joaquin	7.38	110	7.38	1
Pan_de_Azucar	Ovalle	151.58	110	75.79	2
Pan_de_Azucar	Rivadavia	76.37	110	76.37	1
Pan_de_Azucar	Marquesa	40.45	66	40.45	1
Pan_de_Azucar	Tap_Las_Companias	30	110	30	1
Pangue	Tap_Trupan	54	220	54	1
Pangue	Charrua	75.81	220	75.81	1
Paniahue	Marchigue	76.08	66	38.04	2
Parral	Cauquenes	51.1	66	51.1	1
Pehuenche	Ancoa	24.5	220	24.5	1

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Pehuenche	Tap_Loma_Alta	4.5	220	4.5	1
Pelequen	San_Vicente_de_Tagua	20.58	66	20.58	1
Pelequen	San_Fernando	10	66	10	1
Pellets	Tap_Pellets	20	110	10	2
Penco	Lirquen	4.31	66	4.31	1
Petropower	Petroquimicas	10	110	10	1
Petroquimicas	San_Vicente	2	66	2	1
Peuchen	Mampil	10.5	220	10.5	1
Pichirropulli	La_Union	22.5	66	22.5	1
Pid_Pid	Castro	8.07	110	8.07	1
Pilmaiquen	Tap_Los_Negros	17	66	8.5	2
Polpaico	Los_Maitenes	59.8	220	59.8	1
Polpaico	Quillota	99.16	220	49.58	2
Polpaico	El_Salto	100.64	220	50.32	2
Portezuelo	Marchigue	7.66	66	7.66	1
Portezuelo	La_Esperanza	7.6	66	7.6	1
Puclaro	Marquesa	10	110	10	1
Puente_Alto	Costanera	3.6	110	3.6	1
Puerto_Montt	Melipulli	0.57	220	0.19	3
Puerto_Montt	Barro_Blanco	100	220	100	1
Puerto_Montt	Valdivia	216.82	220	216.82	1
Puerto_Varas	Melipulli	30.48	66	15.24	2
Pullinque	Loncoche	87.32	66	43.66	2
Pumahue	Chivilcan	4.65	66	4.65	1
Punitaqui	Central_Punitaqui	5	66	5	1
Punta_Barranco	Punta_San_Gallan	3.6	110	3.6	1
Punta_Colorada	Maitencillo	218.36	220	109.18	2
Punta_de_Cortes	Cachapoal	17	66	8.5	2
Punta_de_Cortes	Lo_Miranda	12.2	66	6.1	2
Punta_Peuco	Las_Vegas	36.9	110	36.9	1
Punta_San_Gallan	Chomeco	13.3	110	13.3	1
Puntilla	Puente_Alto	0.2	110	0.2	1
Purranque	Frutillar	60	66	30	2
Central_Quellon	Quellon	5	110	5	1
Quelentaro	Las_Aranas	23.19	110	23.19	1
Quelentaro	Portezuelo	36.85	110	36.85	1
Charrua	Tap_Trupan	135	220	30	1
Antuco	Tap_Trupan	135	220	37.5	1
Quillota	San_Pedro	4.4	110	2.2	2
Quillota	Nogales	54	220	27	2
Quinquimo	Cabildo	28.81	110	28.81	1
Quinquimo	Quillota	68.82	110	68.82	1
Quinta	Curico	30	66	30	1
Quintero	San_Luis	26.6	220	26.6	1

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Rancagua	Alameda	0.16	66	0.16	1
Rancagua	Paine	10	66	10	1
Rancagua	Tap_Los_Lirios	10	66	10	1
Rapel	Quelentaro	0.63	220	0.63	1
Rapel	Marchigue	50.15	66	50.15	1
Rapel	Nihue	7.45	66	7.45	1
Rapel	Bajo_Melipilla	115.02	220	57.51	2
Nueva_Renca	Brasil	6.34	110	3.17	2
Nueva_Renca	Metro	5.56	110	5.56	1
Rivadavia	El_Indio	87	110	87	1
Rosario	Tap_Rengo	10	66	10	1
Rucue	Quilleco	40	220	20	2
Quilleco	Charrua	71.2	220	35.6	2
San_Clemente	Chiburgo	7.22	66	7.22	1
San_Fco_Mostazal	Hospital	10	66	10	1
San_Fernando	Colchagua	0.58	66	0.58	1
San_Fernando	San_Vicente_de_Tagua	25.6	66	25.6	1
San_Fernando	Nancagua	18.2	66	18.2	1
San_Fernando	Quinta	23.08	66	23.08	1
San_Ignacio	Talca	23.5	66	23.5	1
San_Isidro	San_Luis	30	110	30	1
San_Javier	Constitucion	77	66	77	1
San_Javier	Linares	29	66	29	1
San_Jeronimo	Las_Pinatas	2.5	66	2.5	1
San_Juan	Pan_de_Azucar	8	66	4	2
San_Lorenzo	Diego_de_Almagro	0.3	220	0.3	1
San_Luis	Quillota	15.94	220	7.97	2
San_Luis	Agua_Santa	33.39	220	33.39	1
San_Pedro	Las_Vegas	60	110	30	2
San_Pedro	Miraflores	56.5	110	28.25	2
San_Vicente_de_Tagua	El_Manzano	39.6	66	39.6	1
San_Vicente	Talcahuano	1	154	1	1
Chillan	Nueva_Aldea	37.1	66	37.1	1
Santa_Maria	Charrua	148.6	220	74.3	2
Santa_Rosa	Alhue	31.11	66	31.11	1
Sauzal	Rancagua	13	154	13	1
Sauzal	Alto_Jahuel	121.4	110	60.7	2
Sauzal	Coya	14.2	66	14.2	1
Sauzal	Candelaria	40	110	40	1
Sauzalito	Sauzal	10	110	10	1
Sewel	Coya	40	66	20	2
Talca	Piduco	2.94	66	2.94	1
Talca	Tap_San_Rafael	40	66	20	2
Talcahuano	Latorre	6.96	66	3.48	2

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Talcahuano	Perales	4.88	66	4.88	1
Tap_Agua_Negras	Tinguiririca	63.43	154	63.43	1
Tap_Algarrobo	San_Jeronimo	0.01	66	0.01	1
Tap_Algarrobo	Maitencillo	40	110	40	1
Tap_Algarrobo	Algarrobo	5	110	5	1
Tap_Alto_Melipilla	Bajo_Melipilla	4.06	110	4.06	1
Tap_Alto_Melipilla	Bollenar	19.13	110	19.13	1
Tap_Alto_Melipilla	Alto_Melipilla	1.82	220	0.91	2
Tap_Casablanca	San_Antonio	60	66	30	2
Tap_Casablanca	Casablanca	30	66	30	1
Tap_Castilla	Tap_Los_Colorados	44.2	110	44.2	1
Tap_Castilla	Castilla	8	110	8	1
Tap_Chena	Chena	0.94	220	0.47	2
Tap_Curillinke	Itahue	101.2	154	101.2	1
Tap_Curillinke	Curillinke	3	154	3	1
Tap_Dos_Amigos	Tap_Algarrobo	60	110	60	1
Tap_Dos_Amigos	Dos_Amigos	8	110	8	1
Tap_Ejercito	Ejercito	0.31	66	0.31	1
Tap_El_Sauce	Combarbala	10	66	10	1
Tap_El_Sauce	El_Sauce	5	66	5	1
Tap_Graneros	Graneros	0.06	66	0.06	1
Tap_Graneros	San_Fco_Mostazal	10	66	10	1
Tap_Guayacan	Tap_Puntilla	20	110	10	2
Tap_Guayacan	Guayacan	10	110	10	1
Tap_Huellehue	Valdivia	18.42	66	18.42	1
Tap_Huellehue	Huellehue	5	66	5	1
Tap_Impulsion	Impulsion	3	110	3	1
Tap_Impulsion	Caldera	54.2	110	54.2	1
Tap_Incahuasi	Tap_Pajonales	5	110	5	1
Tap_Incahuasi	Incahuasi	5	110	5	1
Tap_La_Laja	Alto_Jahuel	60	110	30	2
Tap_La_Laja	Tap_Maitenes	40	110	20	2
Tap_Las_Companias	Las_Companias	5	110	5	1
Tap_Las_Companias	Tap_Romeral	5	110	5	1
Tap_Lautaro	Victoria	29	66	29	1
Tap_Loma_Alta	Loma_Alta	23	220	23	1
Tap_Loma_Alta	Ancoa	20	220	20	1
Tap_Loma_Colorada	Loma_Colorada	1	66	1	1
Tap_Loma_Colorada	Tap_Petrox	10	66	5	2
Tap_Loma_Colorada	Coronel	10	66	5	2
Tap_Puntilla	Queltehues	20	110	10	2
Tap_Los_Colorados	Maitencillo	44.2	110	44.2	1
Tap_Los_Colorados	Los_Colorados	8	110	8	1
Tap_Los_Lirios	Cachapoal	10	66	10	1

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Tap_Los_Lirios	Los_Lirios	10	66	10	1
Tap_Los_Maquis	Los_Maquis	0.6	110	0.3	2
Tap_Los_Maquis	Las_Vegas	80	110	40	2
Tap_Los_Morros	Tap_Guayacan	20	110	10	2
Tap_Los_Morros	Los_Morros	10	110	10	1
Tap_Los_Negros	Osorno	70	66	35	2
Tap_Los_Negros	Los_Negros	10	66	5	2
Tap_Maitenes	Tap_Los_Morros	60	110	30	2
Tap_Maitenes	Maitenes	20	110	10	2
Tap_Mandinga	Las_Aranas	15	66	15	1
Tap_Mandinga	Mandinga	3	66	3	1
Tap_Monte_Patria	Ovalle	60	66	30	2
Tap_Monte_Patria	Monte_Patria	10	66	5	2
Tap_Pachacama	La_Calera	16	110	8	2
Tap_Pachacama	Las_Vegas	28.2	44	14.1	2
Tap_Pachacama	San_Pedro	33.24	44	16.62	2
Tap_Pajonales	Tap_Dos_Amigos	5	110	5	1
Tap_Pajonales	Pajonales	5	110	5	1
Tap_Pellets	Maitencillo	60	110	30	2
Tap_Penco	Concepcion	10	66	10	1
Tap_Penco	Penco	5	66	5	1
Tap_Petrox	Concepcion	30	66	15	2
Tap_Pitrufulquen	Loncoche	120	66	40	3
Tap_Pitrufulquen	Pitrufulquen	10	66	10	1
Tap_Potrerillos	Diego_de_Almagro	28.82	110	14.41	2
Tap_Potrerillos	Potrerillos	57.64	110	28.82	2
Tap_Punitaqui	Tap_El_Sauce	25	66	25	1
Tap_Punitaqui	Punitaqui	5	66	5	1
Tap_Puntilla	Puntilla	10	110	10	1
Tap_Queilen	Puqueldon	60	66	60	1
Tap_Queilen	Queilen	110	66	110	1
Tap_Queilen	Quellon	53.29	110	53.29	1
Tap_Quinenco	Bocamina	2.91	154	2.91	1
Tap_Renca	San_Cristobal	80	110	40	2
Tap_Renca	Tap_La_Laja	20	110	10	2
Tap_Renca	Alfalfal	100	220	50	2
Tap_Renca	Alto_Jahuel	160	220	80	2
Tap_Rengo	Rengo	0.48	66	0.48	1
Tap_Rengo	Pelequen	10	66	10	1
Tap_Romeral	Tap_Incahuasi	65	110	65	1
Tap_Romeral	Romeral	10	110	10	1
Tap_San_Rafael	San_Rafael	4.2	66	2.1	2
Tap_San_Rafael	Itahue	44.74	66	22.37	2
Tap_Tuniche	Tinguiririca	160	154	80	2

Table S5. *Cont.*

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Tap_Tuniche	Rancagua	10	154	10	1
Temuco	Cautin	4	220	2	2
Temuco	Pumahue	0.84	66	0.42	2
Temuco	El_Rosal	100	220	100	1
Temuco	Chivilcan	2	66	2	1
Temuco	Tap_Lautaro	30	66	30	1
Temuco	Temuco_Sur	3.06	66	1.02	3
Temuco_Sur	Tap_Pitrufquen	120	66	40	3
Teno	Agua_Negras	0.11	66	0.11	1
Tierra_Amarilla	Plantas	8.5	110	8.5	1
Tierra_Amarilla	Atacama_Kozan	4	110	4	1
Tinguiririca	San_Fernando	7.44	154	3.72	2
Tome	Cocharcas	5	66	5	1
Torquemada	Miraflores	28.2	110	14.1	2
Torquemada	Concon	0.54	110	0.27	2
Trapen	Los_Molinos	5	110	5	1
Tres_Pinos	Lebu	27.26	66	27.26	1
V_PRAT	Tap_San_Rafael	15	66	15	1
Valdivia	Picarte	10.1	66	5.05	2
Valdivia	Chumpullo	1.6	66	1.6	1
Valdivia	Ciruelos	49	220	49	1
Vallenar	El_Eden	0.01	110	0.01	1
Ventanas	Nogales	60.2	220	30.1	2
Victoria	Traigen	32.27	66	32.27	1
Victoria	Curacautin	45.34	66	45.34	1
Victoria	Collipulli	30.11	66	30.11	1
Vizcachas	Puente_Alto	8.6	110	8.6	1
Ovalle	El_Penon	80	66	80	1
Angol	Los_Sauces	40	110	20	2
Central_Curacautin	Curacautin	40	110	20	2
Traigen	Central_Traigen	40	110	20	2
Central_Ancud	Ancud	40	110	20	2
Central_Collipulli	Collipulli	40	110	20	2
Casablanca	Central_Casablanca	40	110	20	2
Central_Las_Vegas	Tap_Casablanca	40	110	20	2
Casablanca	Curauma	40	110	20	2
Planta_Maule	Constitucion	40	110	20	2
Rancagua	Central_Esperanza	40	110	20	2
Quintay	Agua_Santa	40	110	20	2
Central_Linares	Linares	40	110	20	2
Tapihue	Casablanca	40	110	20	2
Colihue	Rancagua	80	110	40	2
Planta_Curico	Curico	80	110	40	2
Bio_Bio	Petrox	40	110	20	2

Table S5. Cont.

End 1	End 2	Weight	Voltage (kV)	Length (km)	The number of lines
Ojos_de_Agua	Cipreses	40	110	20	2
Lebu	Central_Lebu	40	110	20	2
Totoral	Eolica_Totoral	40	110	20	2
Canela	Punta_Colorada_Eolica	40	110	20	2
Yungay	Central_Yungay	40	110	20	2

4. Power plant nodes list

Table S6. Power plants nodes.

Node name	Power plant	Power plant unit	Generation of power plant unit (MWh)	Generation of the node (MWh)	Power source
Abanico	Abanico	ABANICO	341,539	341,539	Hydro run of the river
Aconcagua	Juncal	ACONCAGUA	404,479	404,479	Hydro run of the river
Alfalfal	Alfalfal	ALFALFAL	893,803.63	893,804	Hydro run of the river
Central_Ancud	Ancud	Ancud	834.3	834	Diesel oil
Antilhue	Antilhue TG	ANTILHUE TG	135,817	135,817	Diesel oil
Antuco	Antuco	ANTUCO	1,448,334	1,448,334	Hydro reservoir
Arauco	Arauco	ARAUCO	15,219.3	15219	Biomass
Bocamina	Bocamina	BOCAMINA	928,573	1,435,795	Coal
	Bocamina II	Bocamina 2	507,222.2		Coal
Cabrero	Cabrero	Cabrero	45,954.7	45,955	Biomass
Central Calle Calle	CalleCalle	Calle-Calle	14,185	14,185	Diesel oil
Campanario	Campanario	Campanario	4562.4	30,419	Diesel oil
	Campanario	Campanario Diesel	25,856.662		Diesel oil
	Candelaria	Candelaria	31,801.5		Natural gas
Central_Candelaria	Candelaria	Candelaria Diesel	123,265	166,375	Diesel oil
	Candelaria	Candelaria LNG	11,308		LNG
	Canela	Canela	28,169.01		Wind
Canela	Canela II	Canela 2	115,217.73	143,387	Wind
	Canutillar	CANUTILLAR	1,044,127		Hydro reservoir
Capullo	Capullo	CAPULLO	68,601	68,601	Hydro run of the river
Carena	Carena	Carena	63,721.05	63,721	Hydro run of the river
Central_Casablanca	Casablanca 1	Casablanca	751.5445102	752	Diesel oil
Celco	Celco	CELCO	40,588.5	40,589	Biomass
Bio_Bio	CBB-Centro	Cem Bio Bio	57,558	57,558	Fuel Oil
Cenizas	Cenizas	Cenizas	42,270.3	42,270	Diesel oil
Chacabuquito	Chacabuquito	CHACABUQUITO	161,005.6	161,006	Hydro run of the river

Table S6. *Cont.*

Node name	Power plant	Power plant unit	Generation of power plant unit (MWh)	Generation of the node (MWh)	Power source
Chacayes	Chacayes	Chacayes	302,086.1	302,086	Hydro run of the river
Chiburgo	Chiburgo	Chiburgo	71,696.35	71,696	Hydro run of the river
Central_Chiloe	Chiloé	Chiloé	763.32	763	Diesel oil
Cholguan	Cholguán	CHOLGUÁN	82,931.4	82,931	Biomass
Chuyaca	Chuyaca	Chuyaca	5464.8	5465	Diesel oil
Cipreses	Cipreses	CIPRESES	498783	498,783	Hydro reservoir
Colbun	Colbún	COLBUN	2110155	2,110,155	Hydro reservoir
Colihue	Colihues	COLIHUES	49,957.86	49,958	Diesel oil
Central_Collipulli	Collipulli	Collipulli	1429.7	1430	Diesel oil
Colmito	Colmito	Colmito	3975.08	3975	Diesel oil
La_Confluencia	La Confluencia	Confluencia	130,511.9	130,512	Hydro run of the river
Central_Constitucion	Constitución	CONSTITUCION	53,641.76	56,723	Biomass
	Constitución 1	Constitución 1	3080.8		Diesel oil
Central_Coronel	Coronel	CORONEL TG	22,685.9	85,927	Natural gas
	Coronel	Coronel TG Diesel	63,240.7		Diesel oil
Coya	Coya	Coya	79,661.2	79,661	Hydro run of the river
Central_Curacautin	Curacautín	Curacautin	2507.6	2508	Diesel oil
Curauma	Curauma	Curauma	1316.900225	1317	Diesel oil
Planta_Curico	Planta Curicó	Curicó	1317.5	1318	Coal
Curillinke	Curillinke	CURILLINQUE	604,620	604,620	Hydro run of the river
Central_Diego_de_Al magro	Diego de Almagro	D. DE ALMAGRO TG	24735	24,735	Diesel oil
Degan	Degañ	Degan	55,179.343	55,179	Diesel oil
El_Manzano	El Manzano	El Manzano	25,370.665	25,371	Hydro run of the river
El_Penon	El Peñón	El Peñón	90,418.5305	90,419	Diesel oil
Central_Salvador	El Salvador	El Salvador	212	212	Diesel oil
El_Toro	El Toro	EL TORO	1,522,309.5	1,522,310	Hydro reservoir
Emelda	Emelda	EMELDA	1186.4	1186	Diesel oil
Puntilla	Puntilla	EPSA	134,080.6	134,081	Hydro run of the river

Table S6. *Cont.*

Node name	Power plant	Power plant unit	Generation of power plant unit (MWh)	Generation of the node (MWh)	Power source
Central_Esperanza	Esperanza	Esperanza	2100.7	2101	Diesel oil
Florida	Florida	FLORIDA	143,168	143,168	Hydro run of the river
Escuadron	Escuadrón	FPC	77,552.95	77,553	Biomass
Guacolda	Guacolda	GUACOLDA 1	1,216,925	4,820,191	Coal + Petcoke
	Guacolda	GUACOLDA 2	1,217,009		Coal + Petcoke
	Guacolda	Guacolda 3	1,192,493.5		Coal + Petcoke
	Guacolda	Guacolda 4	1,193,763.9		Coal + Petcoke
Guayacan	Guayacán	Guayacán	56,030.4	56,030	Hydro run of the river
Central_horcones	Horcones TG	Horcones Diesel	6532.95	6624	Diesel oil
	Horcones TG	HORCONES TG	91.3		Natural gas
Hornitos	Hornitos	Hornitos	186174.65	186,175	Hydro run of the river
Huasco	Huasco TG	HUASCO TG	585	24,127	Diesel oil + Fuel Oil
	Huasco TG	Huasco TG IFO	23,542		Fuel Oil
Isla	Isla	ISLA	488,228	488,228	Hydro run of the river
La_Higuera	La Higuera	La Higuera	168,757.77	168,758	Hydro run of the river
Laguna_Verde	Laguna Verde TV	LAGUNA VERDE	20,180	24,391	Coal
	Laguna Verde TG	LAGUNA VERDE TG	4211		Diesel oil
Central_Laja	Laja	LAJA	46,299	46,299	Biomass
Central_Las_Vegas	Las Vegas	Las Vegas	1583.572	1584	Diesel oil
Central_Lautaro	Lautaro	Lautaro	369.9	131,682	Biomass
	Lautaro	Lautaro-Comasa	131,312.345		Biomass
Central_Lebu	Lebu	Lebu	54.3	54	Diesel oil
Lican	Licán	Licán	62,389.09	62,389	Hydro run of the river
Central_Licanten	Licanten	LICANTÉN	20,269.5	20,270	Biomass
Lircay	Lircay	Lircay	121,778	121,778	Hydro run of the river
Loma_Alta	Loma Alta	LOMA ALTA	270,328	270,328	Hydro run of the river
Loma_los_Colorados	Loma Los Colorados	Loma Los Colorados	7171.2	56147	Biomass
	Loma Los Colorados II	Loma Los Colorados II	48,975.315		Biomass

Table S6. *Cont.*

Node name	Power plant	Power plant unit	Generation of power plant unit (MWh)	Generation of the node (MWh)	Power source
Los_Espinos	Los Espinos	Los Espinos	21,816.75	21,817	Diesel oil
Los_Molles	Los Molles	LOS MOLLES	47,987	47,987	Hydro run of the river
Los_Morros	Los Morros	LOS MORROS	17,972.9	17,973	Hydro run of the river
Los_Pinos	Los Pinos	Los Pinos	174,311	174,311	Diesel oil
Los_Quilos	Los Quilos	LOS QUILOS	262,677.5	262,678	Hydro run of the river
Los_Sauces	Los Sauces	Los Sauces	4660.1	4660	Diesel oil
Los_Vientos	Los Vientos	Los Vientos TG	97,054.77	97,055	Diesel oil
Machicura	Machicura	MACHICURA	481,089	481,089	Hydro reservoir
Maitenes	Maitenes	MAITENES	130,467.3	130,467	Hydro run of the river
Mampil	Mampil	MAMPIL	157,854.36	157,854	Hydro run of the river
Mariposas	Mariposas	Mariposas	29,612.59	29,613	Hydro run of the river
Planta_Maule	Maule	Maule	602.45	602	Diesel oil
Central_Monte_Patria	Monte Patria	Monte Patria	3348.95	3349	Diesel oil
Central_Monte_Redondo	Monte Redondo	Monte Redondo	92,289.55	92,290	Wind
	Nehuenco I	NEHUENCO	3259		Natural gas
	Nehuenco I	Nehuenco Diesel	734,922.5		Diesel oil
	Nehuenco I	Nehuenco LNG	467,693.5		LNG
	Nehuenco II	NEHUENCO II	189,566		Natural gas
	Nehuenco II	Nehuenco II Diesel	1,536,769.5	3878660	Diesel oil
	Nehuenco II	Nehuenco II LNG	917,414		LNG
	Nehuenco 9B	NEHUENCO TG 9B	17,238		Natural gas
	Nehuenco 9B	Nehuenco TG 9B Diesel	9491.5		Diesel oil
	Nehuenco 9B	Nehuenco TG 9B LNG	2305.5		LNG
	Nueva Aldea I	Nueva Aldea	107,480.7		Biomass
	Nueva Aldea II	Nueva Aldea 2	36.6	214406	Diesel oil
	Nueva Aldea III	Nueva Aldea 3	106,888.68		Biomass
Nueva_Renca	Nueva Renca	NUEVA RENCA	36354	2917990	Natural gas
Nueva_Ventanas	Nueva Ventanas	Nueva Ventanas	2012520.5	2012521	Coal

Table S6. *Cont.*

Node name	Power plant	Power plant unit	Generation of power plant unit (MWh)	Generation of the node (MWh)	Power source
Ojos_de_Agua	Ojos de Agua	Ojos de Agua	41,305.68	41,306	Hydro run of the river
Olivos	Olivos	Olivos	28,516.57	28,517	Diesel oil
Palmucho	Palmucho	Palmucho	228,524	228,524	Hydro run of the river
Pangue	Pangue	PANGUE	1,725,084	1,725,084	Hydro reservoir
Pehuenche	Pehuenche	PEHUENCHE	2,475,938	2,475,938	Hydro reservoir
Petropower	Petropower	PETROPOWER	484,359	484,359	Coal + Petcoke
Peuchen	Peuchén	PEUCHEN	221,049.39	221,049	Hydro run of the river
Pilmaiquen	Pilmaiquén	PILMAIQUEN	243,615	243,615	Hydro run of the river
Placilla	Placilla	Placilla	1120.68	1121	Diesel oil
Puclaro	Puclaro	Puclaro	24,379.022	24,379	Hydro run of the river
Pullinque	Pullinque	PULLINQUE	209,844	209,844	Hydro run of the river
Central_Punitaqui	Punitaqui	Punitaqui	3369.3	3369	Diesel oil
Central_Punta_Colorada	Punta Colorada IFO	Punta Colorada	47,399.084	55,783	Diesel oil
Punta_Colorada_Eolica	Punta Colorada	Punta Colorada Wind	8384.2245	8384	Wind
Central_Quellon	Quellón	Quellon	2745.9	18,085	Diesel oil
	Quellón II	Quellón 2	15,338.6		Diesel oil
Queltehues	Queltehues	QUELTEHUES	357,686	357,686	Hydro run of the river
Quilleco	Quilleco	Quilleco	369,801	369,801	Hydro run of the river
Quintay	Quintay	Quintay	2966.896	2967	Diesel oil
Quintero	Quintero	Quintero Diesel	21,985.5	189811	Diesel oil
	Quintero	Quintero LNG	167,825.5		LNG
Ralco	Ralco	RALCO	2,444,309	2,444,309	Hydro reservoir
Rapel	Rapel	RAPEL	635,244	635,244	Hydro reservoir
Rucue	Renca	RENCA	2653	2653	Diesel oil
San_Clemente	San Clemente	SAN CLEMENTE	115,40.6	11,541	Hydro run of the river
C San Fco Mostazal	San Francisco de Mostazal	SAN FCO. MOSTAZAL	2171.8	2172	Diesel oil
Central_Linares	Linares Norte	San Gregorio-Linares	339.325	339	Diesel oil
San_Ignacio	San Ignacio	SAN IGNACIO	200,335	200,335	Hydro run of the river

Table S6. *Cont.*

Node name	Power plant	Power plant unit	Generation of power plant unit (MWh)	Generation of the node (MWh)	Power source
San_Isidro	San Isidro I	SAN ISIDRO	398588	6144265	Natural gas
	San Isidro I	San Isidro Diesel	43621		Diesel oil
	San Isidro I	San Isidro LNG	2331709.5		LNG
	San Isidro II	San Isidro II	8964		Natural gas
	San Isidro II	San Isidro II Diesel	416478.5		Diesel oil
	San Isidro II	San Isidro II LNG	2944903.5		LNG
San Lorenzo	San Lorenzo de Diego de Almagro	San Lorenzo	293.2	293	Diesel oil
Santa_Lidia	Santa Lidia	Santa Lidia	26511.9	26512	Diesel oil
Santa_Maria	Santa Maria	Santa Maria	974439.3	974439	Coal
Sauzal	Sauzal	SAUZAL	427459	427459	Hydro run of the river
Sauzalito	Sauzalito	SAUZALITO	72404	72404	Hydro run of the river
Tapihue	Tapihue	Tapihue	1607.205	1607	Natural gas
Teno	Teno	Teno	58555.96107	58556	Diesel oil
Termopacífico	Termopacífico	Termopacífico	18065.925	18066	Diesel oil
Central_Tierra_Amarilla	Tierra Amarilla	Tierra Amarilla	1471.325	1471	Diesel oil
Totoral	Totoral	Totoral	2358.101	2358	Diesel oil
Eolica_Totoral	Totoral	Totoral (Wind)	81043.3	81043	Wind
Central_Traigen	Traigén	Traigen	2591.094	2591	Diesel oil
Trapen	Trapén	Trapén	82206.28422	82206	Diesel oil
Central_Valdivia	Valdivia	VALDIVIA	225085.6	225086	Biomass
Ventanas	Ventanas 1	VENTANAS 1	883371	2319196	Coal
	Ventanas 2	VENTANAS 2	1435825		Coal
Volcan	Volcán	VOLCAN	102729	102729	Hydro run of the river
	Yungay	Yungay 1 Diesel	583.143	1970	Diesel oil
	Yungay	Yungay 2 Diesel	661.004		Diesel oil
	Yungay	Yungay 3 Diesel	615.75		Diesel oil
	Yungay	Yungay 4 CC Diesel	110.06		Diesel oil
Total			50279752	50279752	

5. Comparison of ranks for provincial GHG emissions of transmission loss.

The provincial GHG emissions of transmission loss based on both energy distance and consumption are as below;

Table S7. Ranks for GHG emissions of transmission loss of provinces.

Province	GHG emissions rank by		Energy distance (TWh•km)
	Electricity consumption	Energy distance	
Santiago	1	1	5001.68
Concepcion	2	6	477.13
Cachapoal	3	4	735.91
Valparaíso	4	16	176.43
Copiapo	5	3	826.93
Nuble	6	9	404.32
Cordillera	7	13	210.27
Bio Bio	8	18	138.48
Elqui	9	2	875.46
Cautín	10	7	440.39
Maipo	11	10	259.14
Colchagua	12	14	206.94
Talca	13	27	76.20
Huasco	14	15	179.28
Quillota	15	28	69.50
Llanquihue	16	20	126.26
Talagante	17	11	247.05
Linares	18	30	36.58
Curico	19	26	94.63
Arauco	20	24	98.67
San Antonio	21	19	127.24
Limari	22	8	434.94
Chacabuco	23	29	60.61
San Felipe	24	31	31.14
Osorno	25	21	107.10
Valdivia	26	25	95.28
Melipilla	27	33	29.23
Los Andes	28	34	24.10
Malleco	29	22	102.94
Chiloe	30	12	239.04
Chanaral	31	5	587.92
Petorca	32	32	31.06
Choapa	33	17	156.95
Cardenal Caro	34	36	9.23
Ranco	35	23	100.86
Cauquenes	36	35	23.28

6. Provincial greenhouse-gas conversion factors in Chile

We derive the regional GHG conversion factors dividing the GHG emission burden by the amount of electricity consumed in each province Table S7 shows the amount of electricity consumption by province.

Table S8. Site-specific Greenhouse gas emission conversion factors of provinces in Chile.

Province	Electricity consumption (GWh)	GHG emissions (kt CO ₂ -eq.)	GHG conversion factor (g CO ₂ -eq./kWh)
Chiloe	399.15	429.51	1076.06
Llanquihue	819.77	226.86	276.74
Ranco	171.46	181.23	1057.04
Valdivia	502.34	171.19	340.80
Osorno	528.30	192.44	364.26
Cautin	1429.46	791.30	553.56
Malleco	406.04	184.97	455.55
Arauco	681.34	177.29	260.21
Bio Bio	1604.06	248.81	155.12
Nuble	1972.70	726.48	368.27
Cauquenes	147.24	41.84	284.13
Talca	983.07	136.92	139.28
Curico	716.11	170.03	237.43
Colchagua	1115.70	371.82	333.27
Cachapoal	3124.76	1322.28	423.16
Talagante	793.27	443.90	559.58
Melipilla	490.27	52.51	107.11
Chacabuco	550.12	108.91	197.98
Concepcion	4042.28	857.31	212.09
Cardenal Caro	208.88	16.58	79.39
Santiago	14,364.57	8987.01	625.64
San Felipe	546.41	55.95	102.39
Los Andes	480.14	43.30	90.18
Quillota	913.03	124.87	136.77
Petorca	308.64	55.80	180.80
Linares	717.46	65.74	91.62
Limari	597.14	781.50	1308.75
Choapa	305.68	282.01	922.57
Elqui	1558.85	1573.03	1009.10
San Antonio	616.34	228.63	370.95
Valparaiso	2543.18	316.85	124.59
Cordillera	1718.53	377.81	219.85
Huasco	937.90	322.13	343.46
Copiapo	2354.35	1485.83	631.10
Chanaral	355.50	1056.38	2971.50

7. Energy Distance Algorithm

The algorithm follows below in Python flavored pseudocode.

```
# this assumes an undirected graph has been constructed before
set nodes' attribute as one of substation, power plant, and tower
set substations ← empty list
set power plants ← empty list

for n in nodes
  set io ← electricity generation # electricity consumption of the node
  if io < 0 # which is a substation
    set demand ← io
    append n to substations
  if io > 0 # which is a power plant
    set supply ← io
    append n to power plants

for n in substations
  set sources ← empty list

for p in power plants
  set d ← the weighted shortest path length from p to n
  append {p: d} to sources of n
  set energy distance ← 0

while all substations' demand is not zero
  for n in substations
    set shortest distance ← the smallest d in sources
    set shortest source ← p of shortest distance
    set starter distance ← the smallest shortest distance of substations
    set target ← a substation which has the starter distance

# start distribution
while target's demand is not zero
  set supplier ← p with the smallest d among remaining sources of target

  if supply of supplier > demand of target
    set transmission ← demand
    set supply ← supply – transmission
    set demand ← 0
    set energy distance ← energy distance + d × transmission

  if supply of supplier = demand of target
    set transmission ← demand
    set supply ← supply – transmission
    set demand ← 0
    set energy distance ← energy distance + d × transmission
    remove p from sources

  if supply of supplier < demand of target
    set transmission ← supply
    set supply ← 0
    set demand ← demand – transmission
    set energy distance ← energy distance + d × transmission
    remove p from sources
```

8. References

1. CDEC-SIC. *CDEC-SIC Operation Statistics 2002–2011*; Centro de Despacho Economico de Carga-Sistema Interconectado Central (CDEC-SIC): Santiago, Chile, 2012; pp. 83–93.
2. CNE. Instalaciones De Transmisión Por Sistema Eléctrico Nacional. Available online: <http://www.centralenergia.cl/en/library/energy-statistics-chile/> (accessed on 7 August 2015).