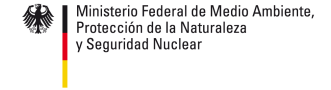




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Por encargo de:



Ministerio Federal de Medio Ambiente,
Protección de la Naturaleza
y Seguridad Nuclear

de la República Federal de Alemania

Roof-top PV – the new market in Chile

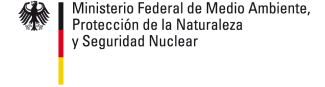


CIREC-Week, 28.10.2015
Matthias Grandel



giz Deutsche Gesellschaft
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de la República Federal de Alemania

GLZ in Chile

- GIZ is a **German Federal Organization** for the sustainable development through international cooperation
- The organization works in more than **130 countries** world wide and has been **25 years in Chile.**
- Together with the chilean Energy Ministry the project “Solar Energy for Power and Heat Generation” has been developed, dedicated to the solar energy self-generation.
- Other projects developed by the **energy program 4E** ofGIZ:
 - CSP and large scale PV plants
 - Efficient cogeneration



Roof-top PV – the new market in Chile

....the legal framework for self-consumption and feed-in is in place.....

....there is market potential and economic feasibility.....

....However, some barriers still exist.....

....but many initiatives underway to remove the barriers.....



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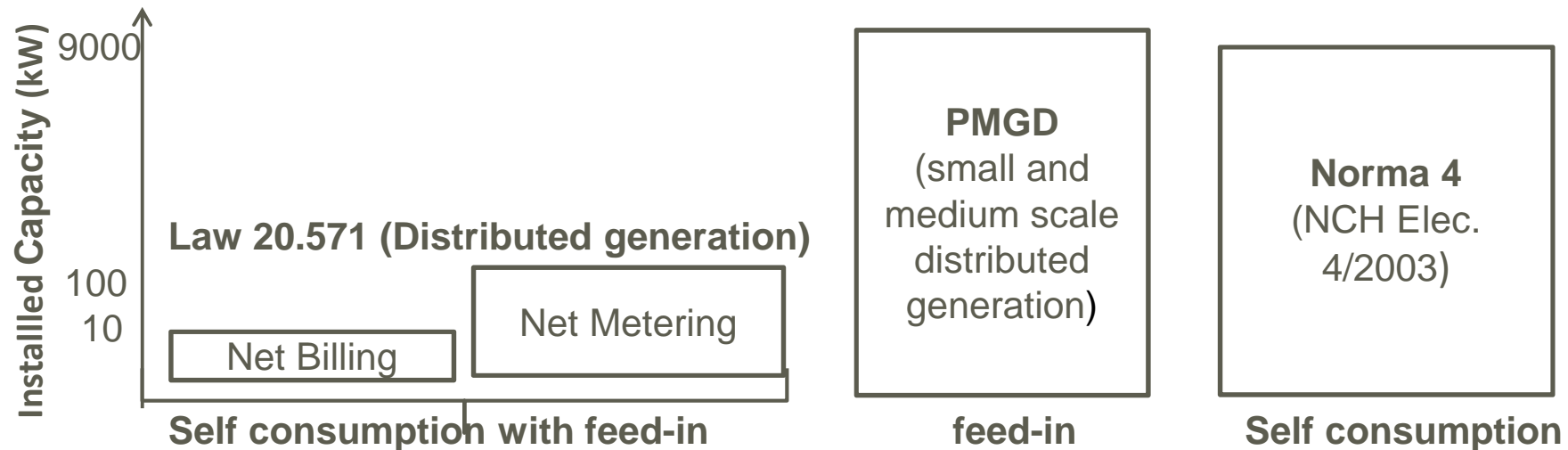
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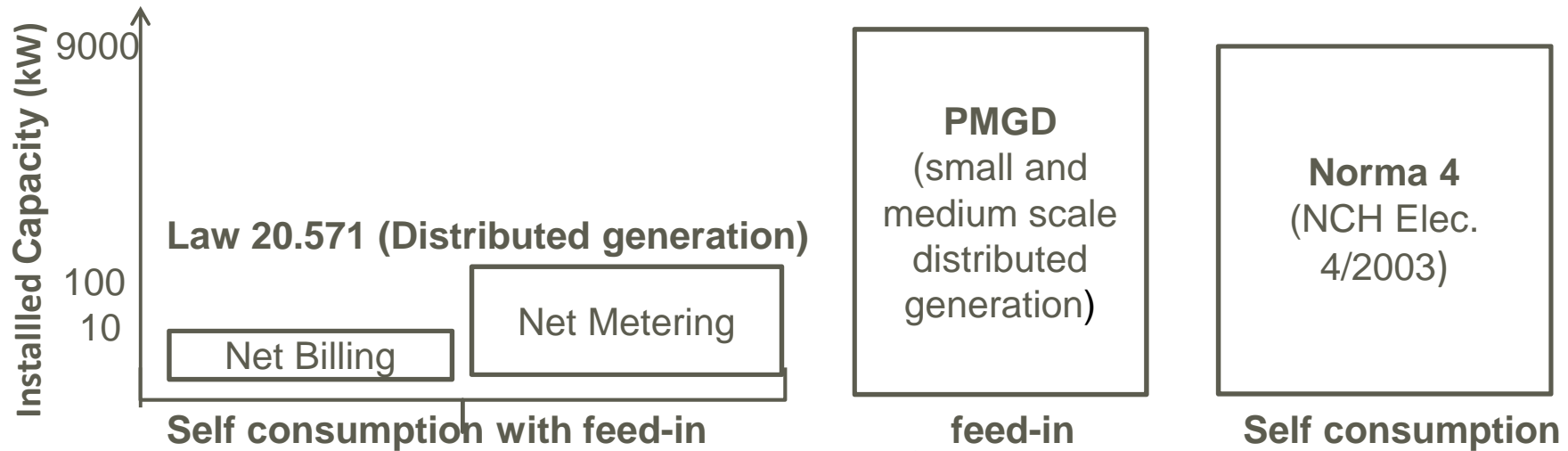
Roof-top PV – Legal Framework



- Distribution company remunerates regulated energy price (59,2 CLP/kWh (8,6 ct US\$) in Santiago)
- Customers with power connection < 10 kW pay integrated price per energy and grid fee (102,3 CLP/kWh (14,8 ct US\$) in Santiago => Net Billing
- Customers with power connections > 10 kW pay for energy and grid separately
-> Net Metering



Roof-top PV – Legal Framework



Installations up to 9 MW can sell excess energy on spot-market, via PPA, or based on regulated wholesale prices

It is also possible to use 100% of produced electricity without feed-in to the network



Roof-top PV – Legal Framework

<http://www.minenergia.cl/ley20571/>



Ministerio de Energía
Gobierno de Chile

Ley 20.571 para la Generación Distribuida

Inicio | Preguntas frecuentes | Clientes Residenciales y Pymes | Otros Clientes Regulados | Información Empresas Instaladoras

¿Cómo funciona la Ley de Generación Distribuida 20.571?

Ejemplo de un Sistema Domiciliario Fotovoltaico

- El campo solar fotovoltaico convierte la energía solar en electricidad.
- El inversor transforma la electricidad producida por el campo solar de corriente continua a corriente alterna, de modo que pueda ser utilizada en tu hogar, escuela, negocio o industria.
- La energía puede ser utilizada durante las horas de sol.
- El medidor bidireccional cuenta tanto la energía que consumes desde la red como aquella que inyectas en forma de excedente, generando dos citas:
 - Consumo de energía desde la red
 - Excedentes que no son aprovechados en tu autoconsumo

El poste de la línea de distribución

Proceso de solicitud de conexión

Ley 20.571

Reglamentos y Normativas

Para recibir noticias sobre materias relacionadas a la ley 20.571 por correo electrónico, escribanos a ley20571@minenergia.cl, utilizando la palabra "Inscribir" en el asunto e indicándonos su nombre y organización (opcional).

22 de octubre de 2014

Máximo Pacheco M.
MINISTRO DE ENERGÍA

"La ley de generación distribuida es el primer paso para la democratización de la energía: garantiza el derecho de los clientes de las empresas distribuidoras a generar su propia energía eléctrica, autoconsumirla y vender sus excedentes energéticos. Además, promueve el uso de las energías renovables no convencionales y los sistemas de cogeneración eficiente, lo que está en línea con nuestro objetivo como país de avanzar hacia una matriz energética más sustentable y diversificada"

Ministerio de Energía
Gobierno de Chile

4e Programa de Energías Renovables y Eficiencia Energética en Chile

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



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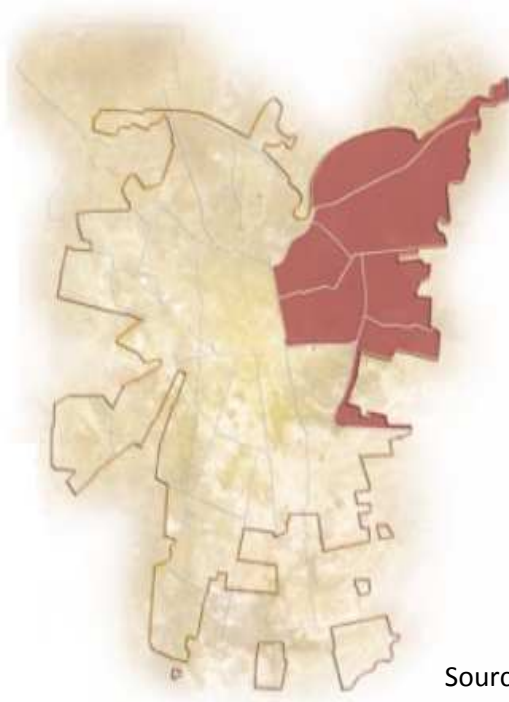
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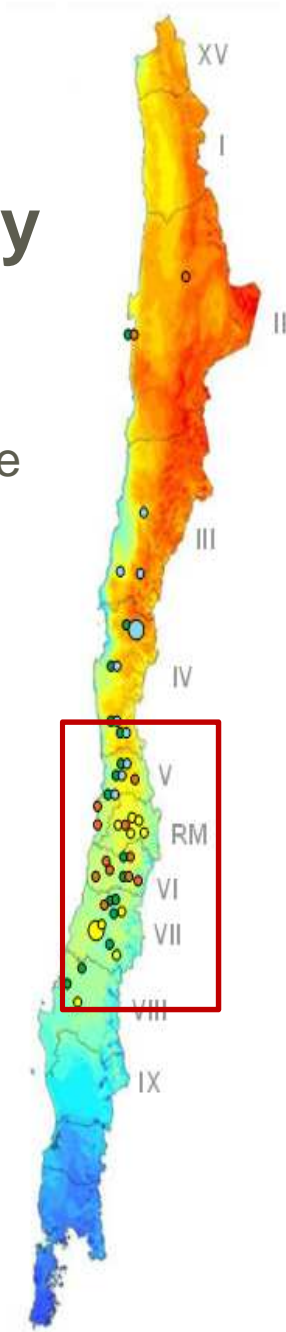
Market Potential and economic feasibility

- Correlation between regulated electricity prices and solar irradiation.
- Higher electricity prices in the southern-central part of Chile drive self-consumption market potential



- ca. 600 thousand households (11% of Santiago's population) with average incomes 3 million CLP/month. (c.a. US\$ 4.500)

- Top 25 BT1
- Top 10 BT1
- Top 1 BT1
- Top 25 AT
- Top 10 AT
- Top 1 AT





Market Potential and economic feasibility

> 25 Technical and economic feasibility studies conducted:

- Arica - Concepción
- All Tariffs: BT1a – AT4.3, clientes libres
- Various economic sectors: Residencial, SME, retail, industry, agriculture, public sector, etc.
- Very high interested of clients/companies





Market Potential and economic feasibility

Profitability depends on:

- Regular (grid) electricity cost vs. self-generated cost
- Capital cost/discount rate
- Share of self-consumption (for residential customers/m SMEs with BT1a)

Example in Santiago:

R: 2,6 kW at 1,3 Mio CLP kWp (incl. IVA) C: 100 kW at 1,0 Mio CLP kWp (sin IVA)	Payback simple	Payback (10% discount rate)
Residential 50% self supply	9 years & 9 months	23 years
Residential 75% self supply	8 years & 7 months	17 years
mSMEs 100% self supply	7 years & 8 months	13 years & 8 months
Commercial (AT 4.3)	10 years & 9 months	> 25 years



Market Potential and economic feasibility

LCOE calculation for Calama:

- red values are higher than the current energy tariff for high tension tariff (AT4.3)

LCOE [CLP/kWh] - 750 kW, Calama									
Investment [USD/kW]	7%	8%	9%	10%	11%	12%	13%	14%	15%
1395	41.7	45.3	49.0	52.8	56.7	60.6	64.7	68.7	72.9
1550	46.4	50.4	54.5	58.7	63.0	67.4	71.8	76.4	81.0
1705	51.0	55.4	59.9	64.5	69.3	74.1	79.0	84.0	89.1
1860	55.7	60.4	65.4	70.4	75.6	80.8	86.2	91.7	97.2
2016	60.3	65.5	70.8	76.3	81.9	87.6	93.4	99.3	105.3



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Market starts very slowly – statistics of Net-Metering/Billing (30.9.):

- Number of “solicitudes de conexión”: 366
- Number of connections “TE4” : 41 in process (674 kW), 15 inscribed (225 kW)

Conclusions from feasibility studies:

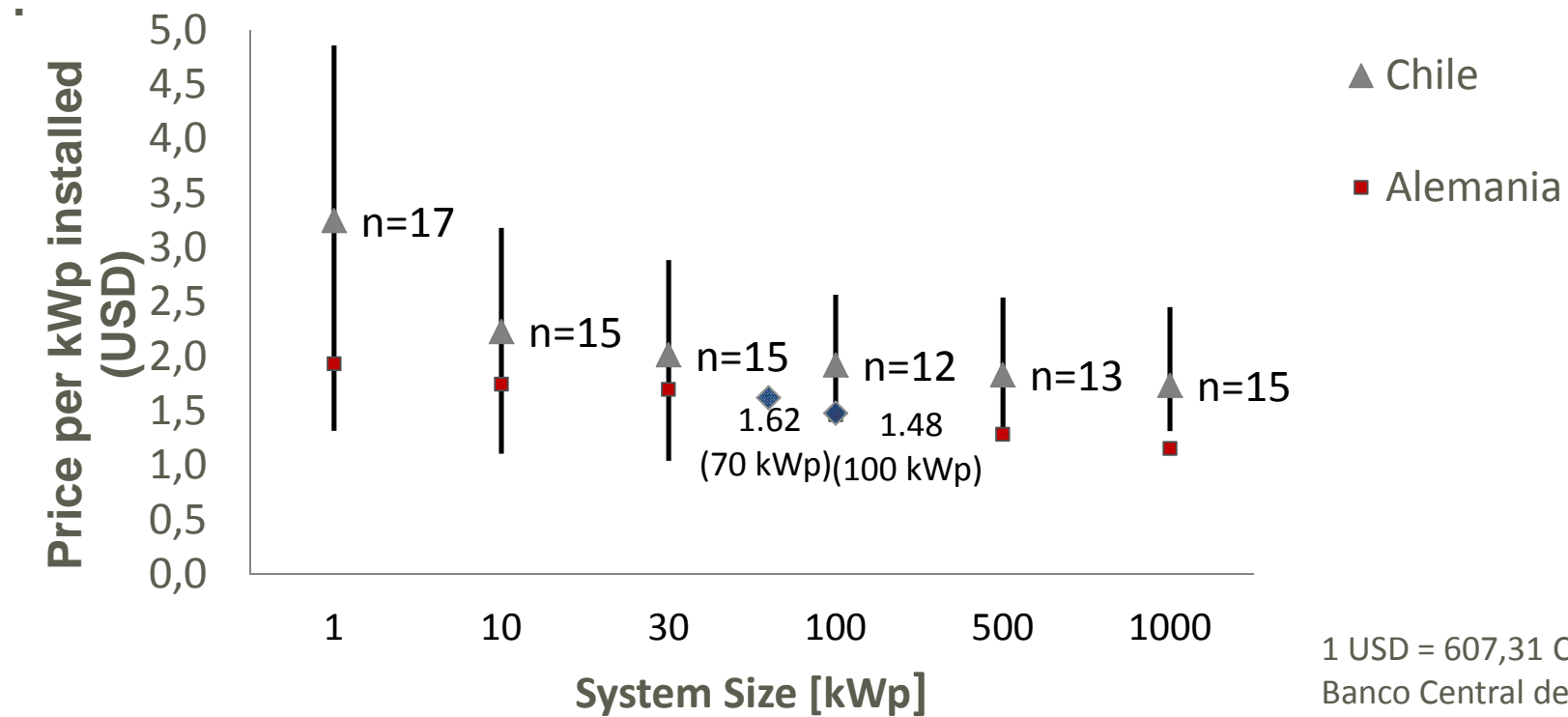
- High profitability expectation of Chilean clients
 - payback < 5 years and very high discount rate (10 – 20%)
-> *Need for new business models ,e.g. ESCO*
- Lack of experience and confidence in purchasing PV-Systems or services
 - Insecurity regarding technical requirements
 - Long decision process
-> *Need for information and patience*



...some barriers still exist...

Prices in Chile still higher than the international price

Comparison of net cost of PV systems by Wp (May 2015)



1 USD = 607,31 CLP
Banco Central de Chile
(13 May, 2015)



...some barriers still exist...

More barriers:

- Local banks usually do not finance small scale projects
- Approx. 150 PV-companies:
 - Mostly new and very small companies with limited project experience
 - only few local and international companies with intensive experience of rooftop-PV

4e Programa de Energía Renovable y Eficiencia Energética en Chile

Por encargo de: Ministerio Federal de Medio Ambiente, Protección de la Naturaleza y Seguridad Nuclear de la República Federal de Alemania

Catastro de empresas solares en Chile Junio 2015

Contexto
En el marco del proyecto "Fomento de la Energía Solar" implementado por el Ministerio de Energía y Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, se ha realizado un catastro de empresas solares presentes en Chile.

Metodología
Las empresas listadas en el catastro fueron pesquisadas mediante revisión de bases de datos de asociaciones gremiales, información web, llamadas telefónicas y contactos electrónicos. Es probable que aquellas empresas no asociadas y sin información disponible en portales web, no estén presentes en este listado. El catastro levantado indica a empresas pertenecientes a los rubros CSP (Concentrated Solar Power), Solar Fotovoltaje (SFV) y Solar Térmico (ST), las cuales se dedican al diseño de proyectos, venta de equipo, instalación, y/o mantenimiento de los mismos.

Listado empresas CSP

Nº	Nombre de la Empresa	Sitio Web
1	Abergos Chile	www.abergos.cl
2	SolarReserve	www.solarreserve.es
3	Biosolca	www.grupobiosolca.es
4	Rioglass Solar Chile SpA	www.rioglass.com
5	Acciona	www.accionacomiles
6	Elector Chile	www.elector.cl/es

Listado empresas FV y ST

Nº	Nombre de la Empresa	Sitio Web
1	Amisolar	www.amisolar.cl
2	Aresol EREN	www.aresol.com
3	Autofame	www.autofame.cl
4	Best Energy	www.best-energy.cl
5	Cent Solar	www.centosolar.cl
6	Comercial Enersoft	www.enersoft.cl
7	Coophk	www.coophk.cl
8	Cosmoglas	www.cosmoglas.cl
9	Ezer	www.ezer.cl
10	Ecogeniería	www.ecol.cl
11	Ecolife	www.ecolife.cl
12	Ecoprotón, energía positiva	www.ecoproton.cl
13	Ecosolar	www.ecosolar.cl
14	Ectel	www.ectel.cl
15	Electrosolar HM	www.electrosolarhm.cl
16	Enateco	www.enateco.cl
17	Enemas Solar	www.enemas.es
18	ERNC Chile	www.erncchile.cl
19	Escon Ingeniería y Eficiencia Energética	www.escon.cl
20	Fluxosolar	www.fluxosolar.cl
21	Geoelectrica ERL	www.geoelectrica.cl

Listado empresas FV

Nº	Nombre de la Empresa	Sitio Web
1	Abergos Chile S.A	www.abergos.cl
2	Albert	www.albert-chile.com
3	Andes Mainstream S.A	http://mainstream.com/chile/
4	Aquilo Solar	www.aquilosolar.cl
5	AR Energía	www.arenergia.cl
6	Arca Solar	www.aricasolar.cl
7	Austral Solar Chile	www.austrialsolar.cl
8	Belectic Chile Ltda.	www.belectic.com/en/Internatio nal/belectic-chile
9	Bezanilla ingeniería y suministros	www.bezanillasolar.cl
10	Carmol	www.carmol.cl
11	Chilecta	www.chilecta.cl
12	Chisol S.A	www.chisol.cl
13	Cresco	www.cresco.cl
14	Ecocrea	www.ecocrea.cl



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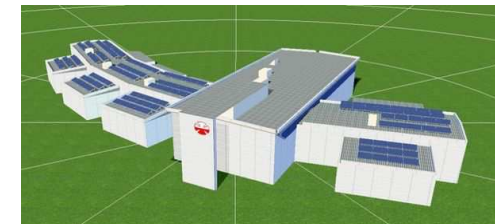
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...activities to remove the barriers...

“Programa Techos Solares Públicos”

- 13 Mio. USD until 2018 for PV-Systems in public buildings
- Open public tender for national and international PV enterprises.
- Size of installations between 5 – 100 kWp.
- Main Objective:
 - Mature the PV-rooftop market by public demand
 - Provide information on costs and conditions
 - Try and improve the legal framework
 - Lower costs of energy in public buildings



www.minenergia.cl/techossolares



...activities to remove the barriers...

Legal and fiscal Analysis of PV-contracting/ESCO business model for PV self-supply:

- The ESCO is owner and responsible for the equipment and the electricity production
- Customers buy the generated electricity





...activities to remove the barriers...

- “solar laboratories” at six vocational training institutions and universities to promote sufficient well-trained installers.
- Laboratories can be rented by companies or other training centers for workshops or training of own technicians.



PV system



Solar laboratories





Conclusion:

The roof-top PV market is up and coming

.... the legal framework for self-consumption and feed-in is in place.....

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Recommendation:

- Enter the market with confidence and patience to convince the potential customers.**
- Offer contracting/ESCO-models and sell only electricity to the customers.**



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Muchas Gracias!

Tienen preguntas?

Matthias Grandel

Asesor Principal

Proyecto Energía Solar para la Generación de Electricidad y Calor

matthias.grandel@giz.de

https://energypedia.info/wiki/Solar_Energy_for_Electricity_and_Heat_in_Chile

www.4echile.cl, www.giz.de



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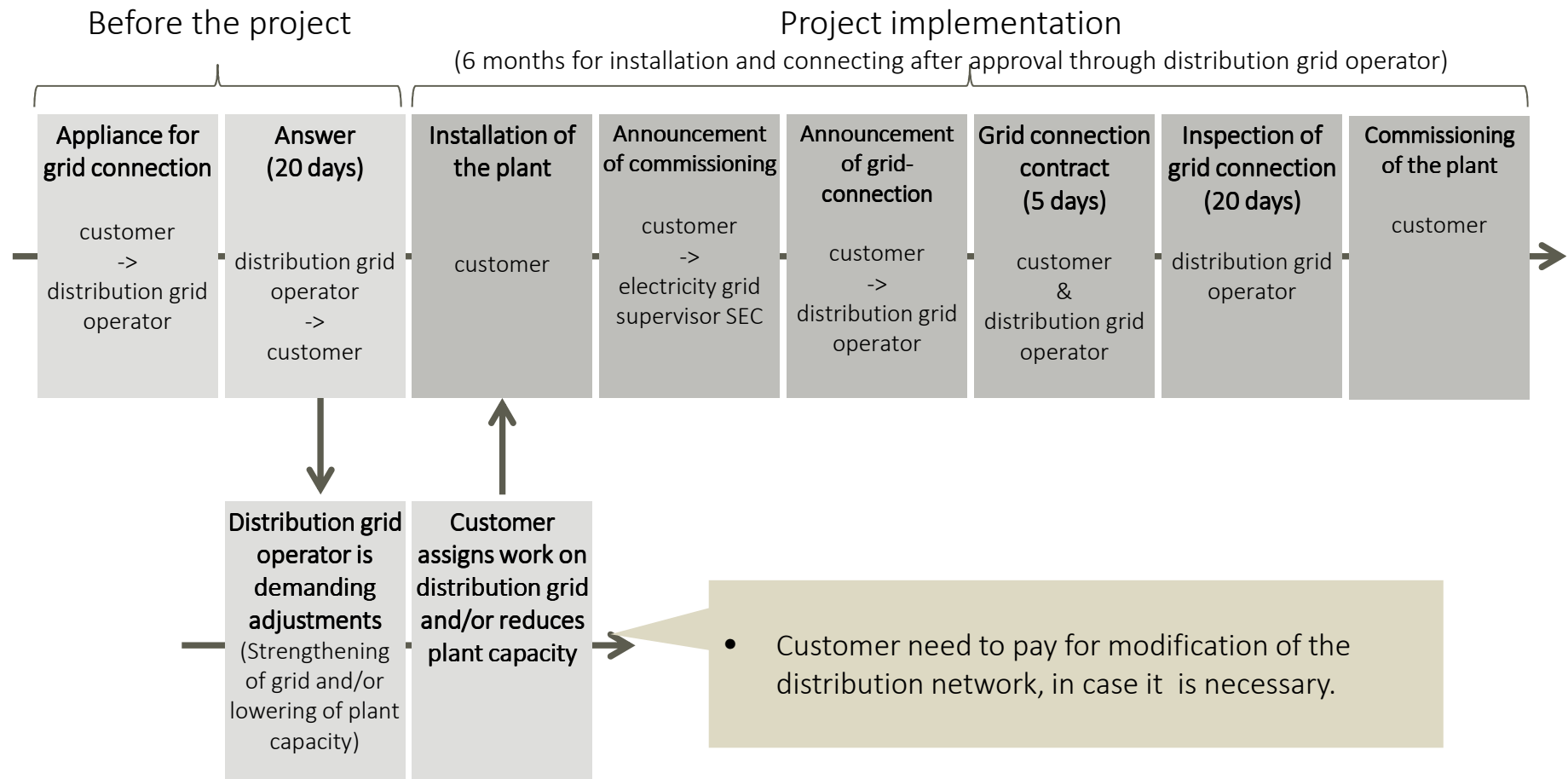
de la República Federal de Alemania

BACK-UP



Legal Framework - one year of Net-Billing/Metering

Application process for plants <100 kW under Net-Billing (simplified)





LCOE calculation

- Parameters for the calculation

Parameters	Value	Unit
Energy generation	1446720	kWh/año
Generation annual losses	0.50%	
unitary investment	1400-2000	USD/kW
Capacity	750	kW
Maintenance costs	0.5 %	% of the investment
Discount rate	7%-15%	
Life time	20	Years
Soc. tax rate	22.5%	% (source: SII)
depreciation type	Lineal	



Data for the profitability calculation

Capacity factor: 20%

System life time: 25 years (with a panels' annual degradation of 0,5%)

Discount rate: 10%

Increase in the electricity price (buy and injection): 3,5%

Inflation: 2%

Annual maintenance cost: 2% of CAPEX

Residential BT1 Tariff (low tension 1), Chilectra distributer:

- Injection: 59.5789 CLP/kWh (net)
- buy: 102.636 CLP/kWh (with IVA)

AT4.3 tariff (high tension 4.3), Chilectra distributer

- Injection: 56,59 CLP/kWh
- buy: 56,59 CLP/kWh

CAPEX 2,6 kW: 2.859.243 (net), with IVA 3.4 Mio. CLP, according to the price index and offers (1.099.708 CLP/kWp (net)) = 1.308.653 CLP/kWp (with IVA)

CAPEX 100kW: 100 000 000 (net), according to the price index