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M4-Integrated District Heating System in Torino and its potential development

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21 January, 2021 SHREC Energy policies and innovative projects in Piemonte

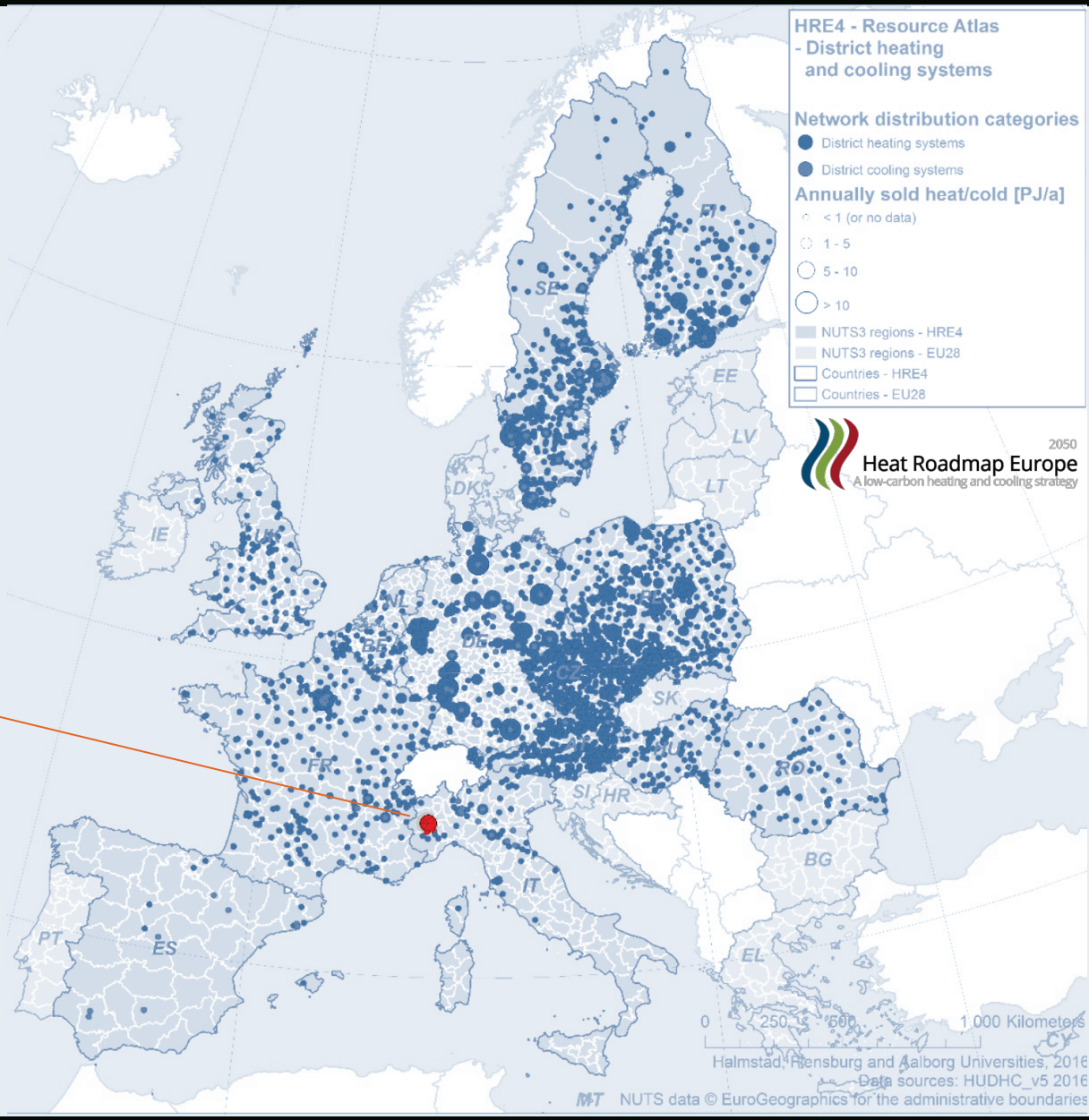
Turin District Heating at the beginning…

Iren Energia (2012) 1982 - 2012 30 years of district heating in Turin

Turin District Heating today

the largest district heating system in Italy

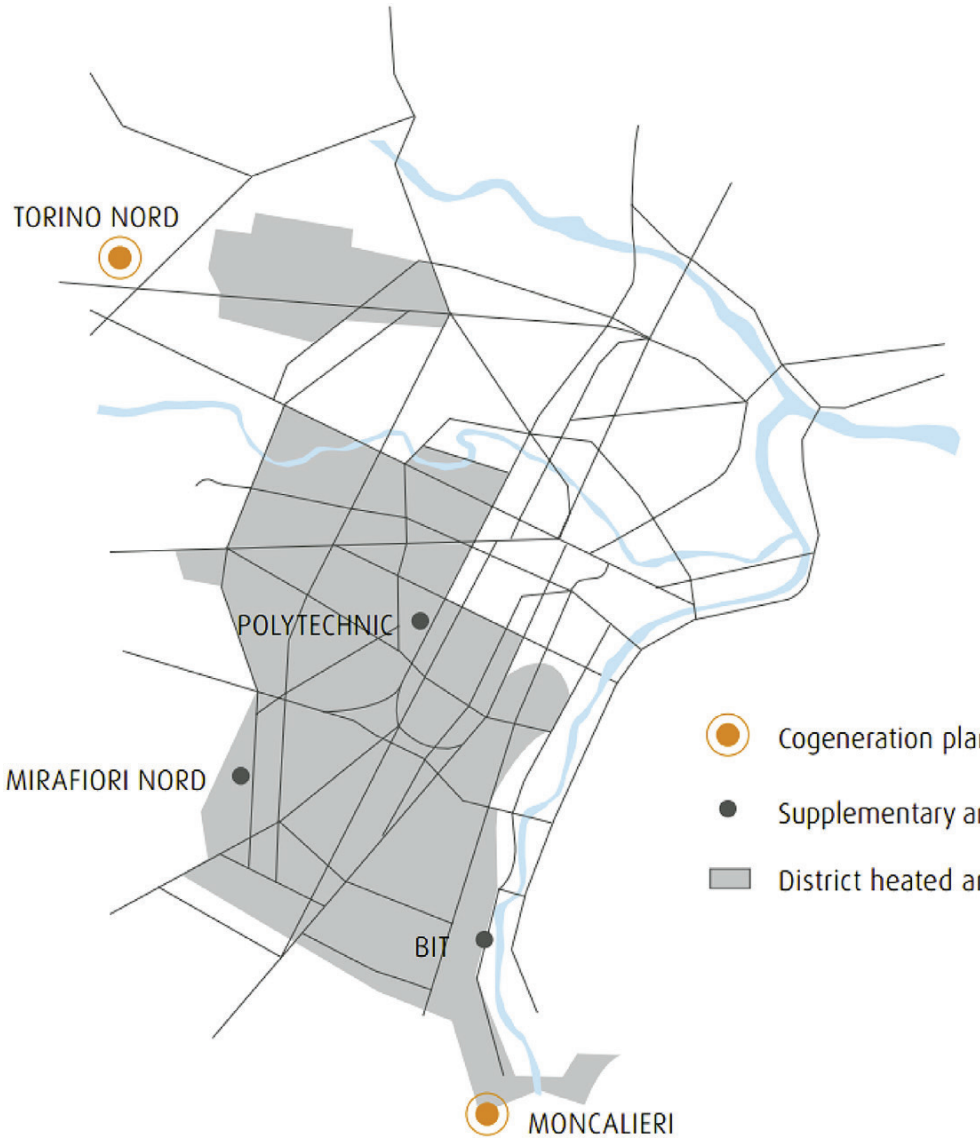
one of the most relevant in Europe

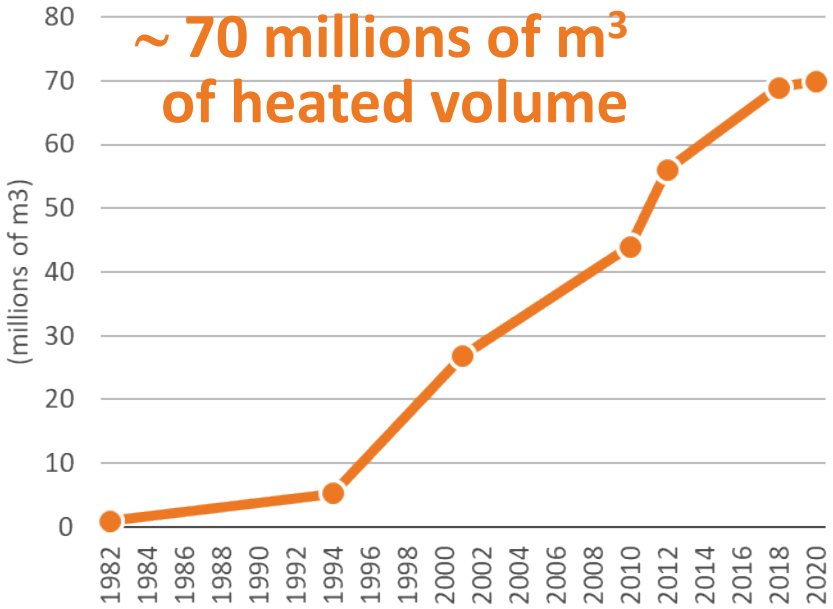


G.V. Fracastoro; A. Poggio (2012) Project Profile: Turin – towards a smart energy city, Cogeneration and On-Site Power Production

U. Persson et al. (2016) A final report outlining the methodology and assumptions used in the mapping, Deliverable 2.3, Heat Roadmap Europe

Turin District Heating today





~ 680 km dual piping

~ 640.000 resident served

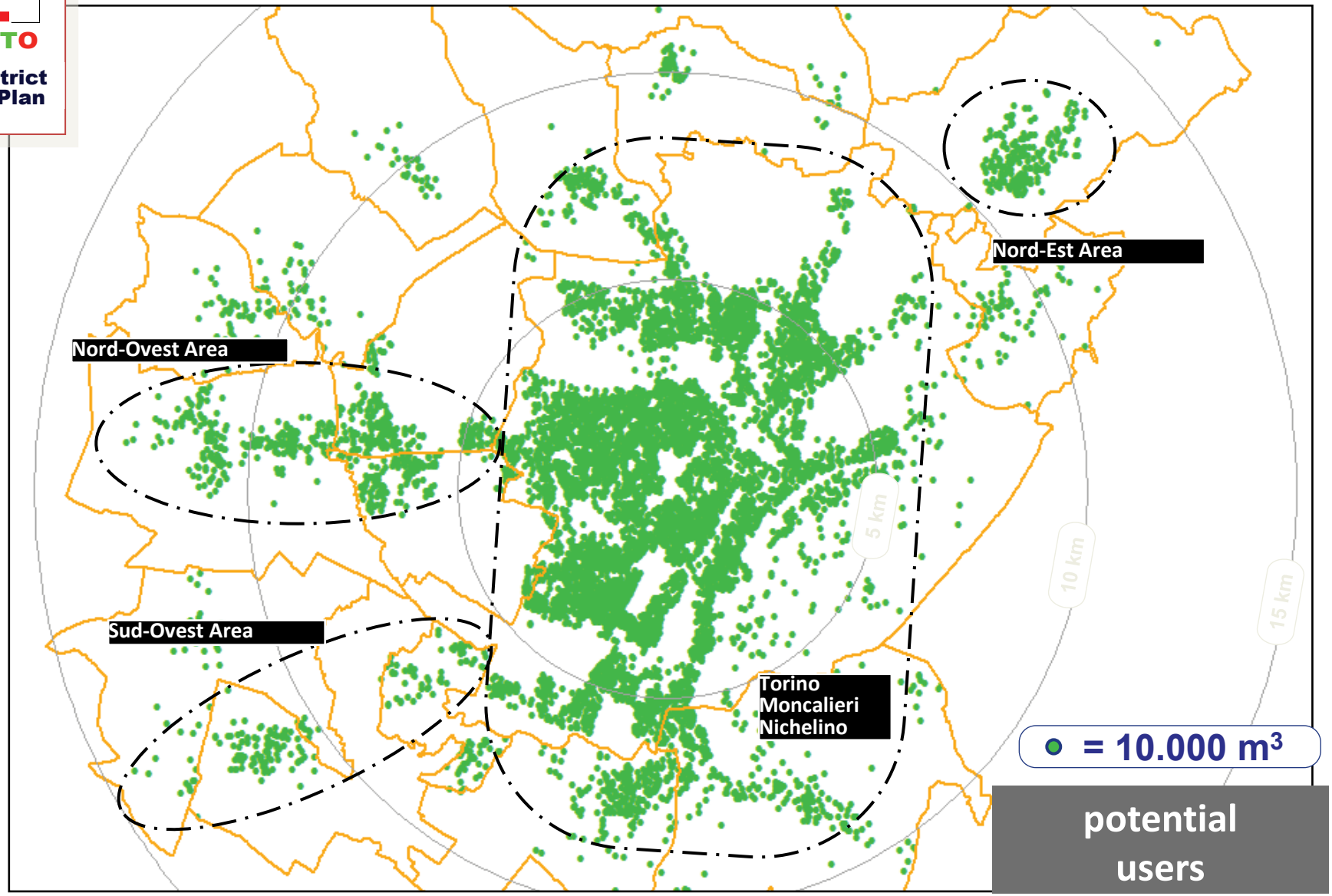
M. Noussan, M. Jarre, A. Poggio (2017) Real operation data analysis on district heating load patterns, Energy

https://dhcities.eu/

https://www.gruppoiren.it/teleriscaldamento-la-rete-iren

Turin District Heating planning

PSTLRTO
Turin District Heating Plan



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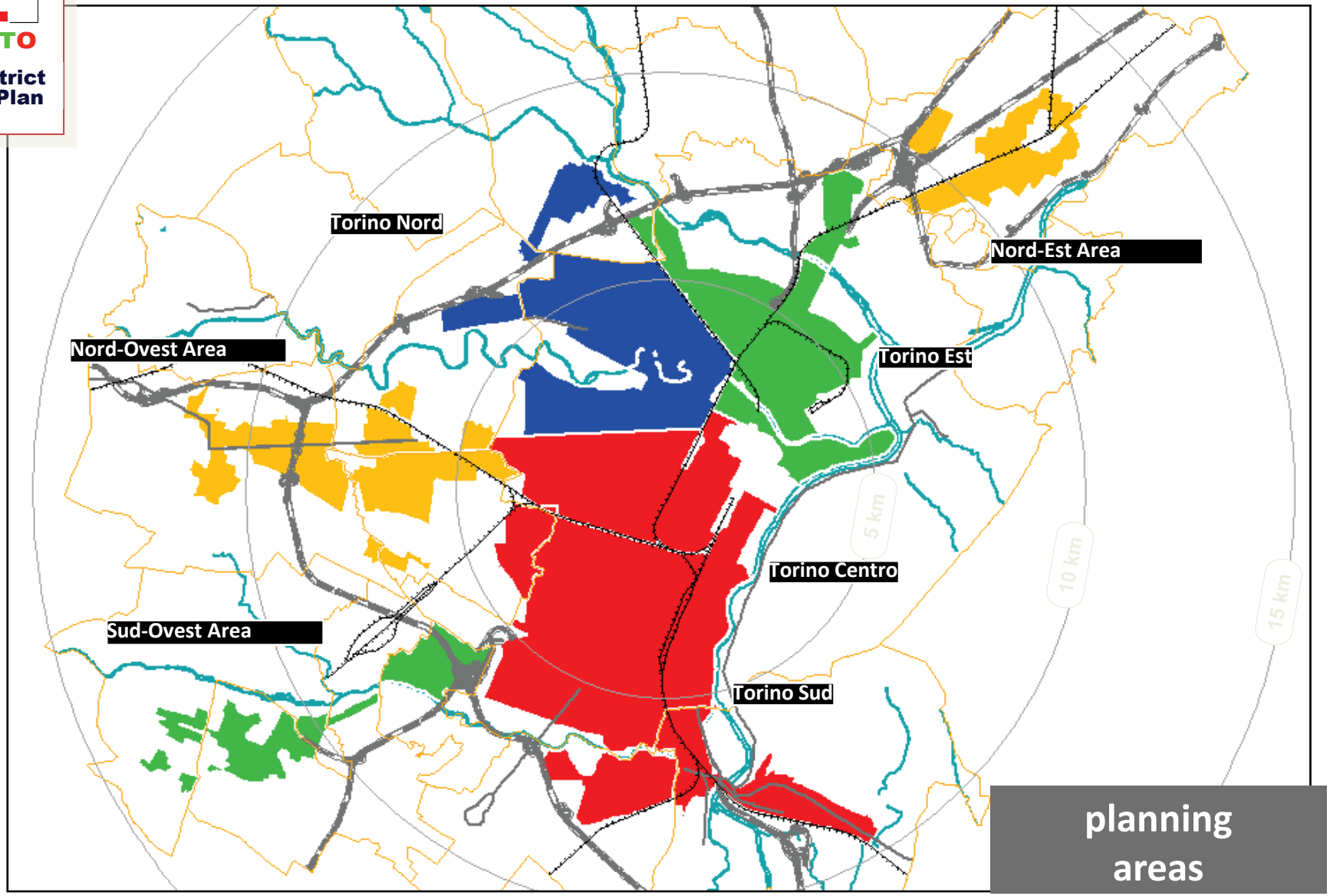
Turin District Heating planning

PSTLRTO
Turin District Heating Plan

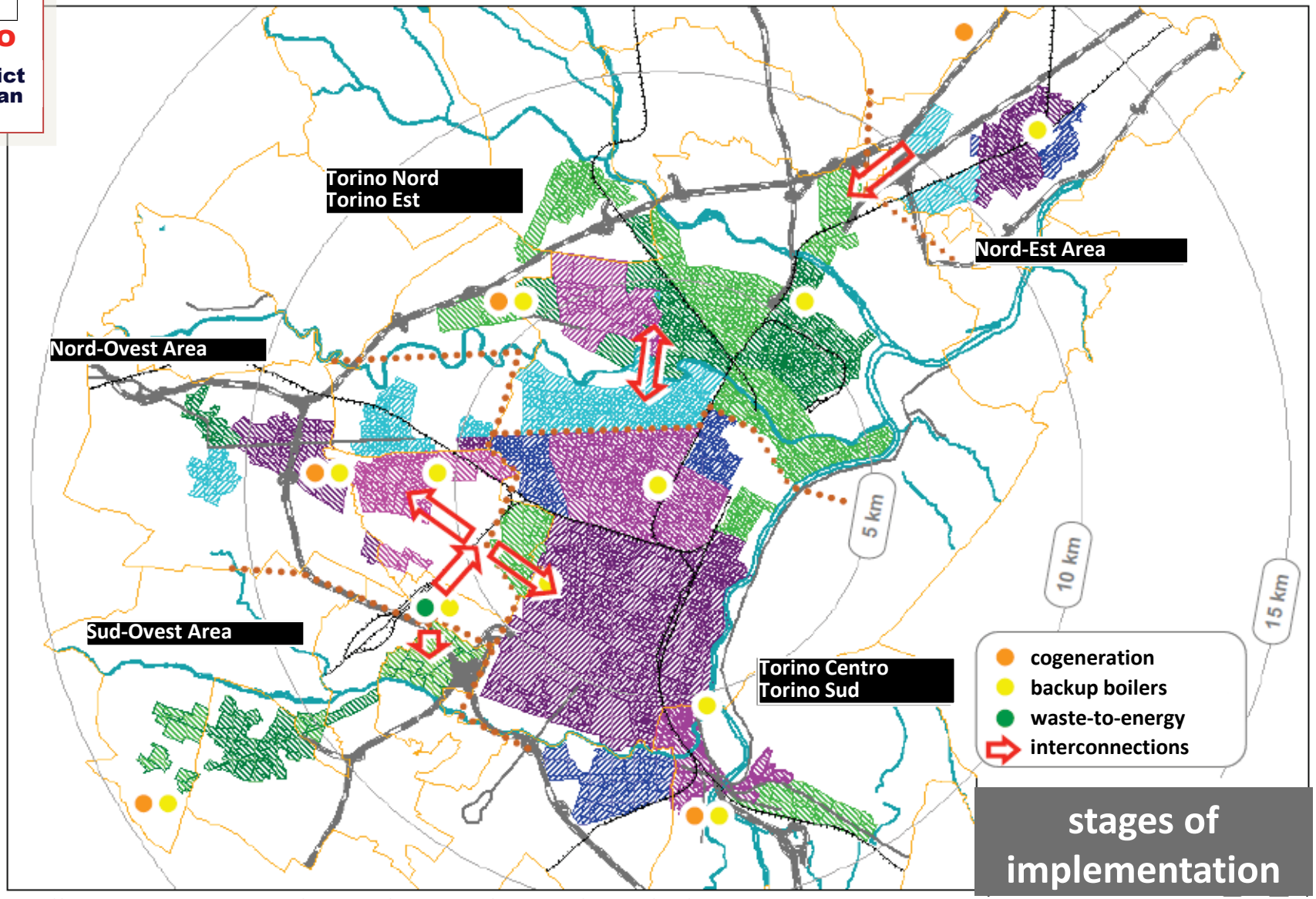


planning areas

http://www.provincia.torino.gov.it/ambiente/file-storage/download/energia/pdf/PSTLRTO.pdf

Turin District Heating planning

PSTLRTO
Turin District Heating Plan

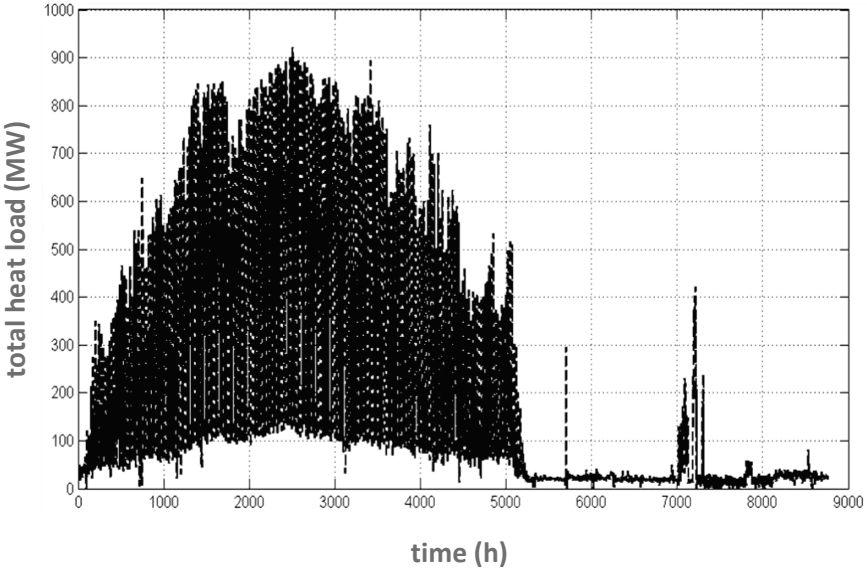


stages of implementation

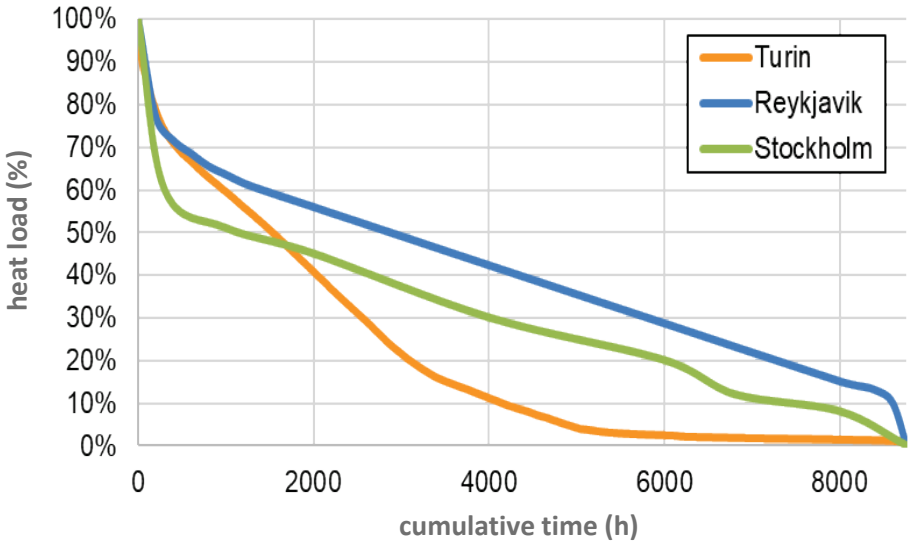
http://www.provincia.torino.gov.it/ambiente/file-storage/download/energia/pdf/PSTLRTO.pdf

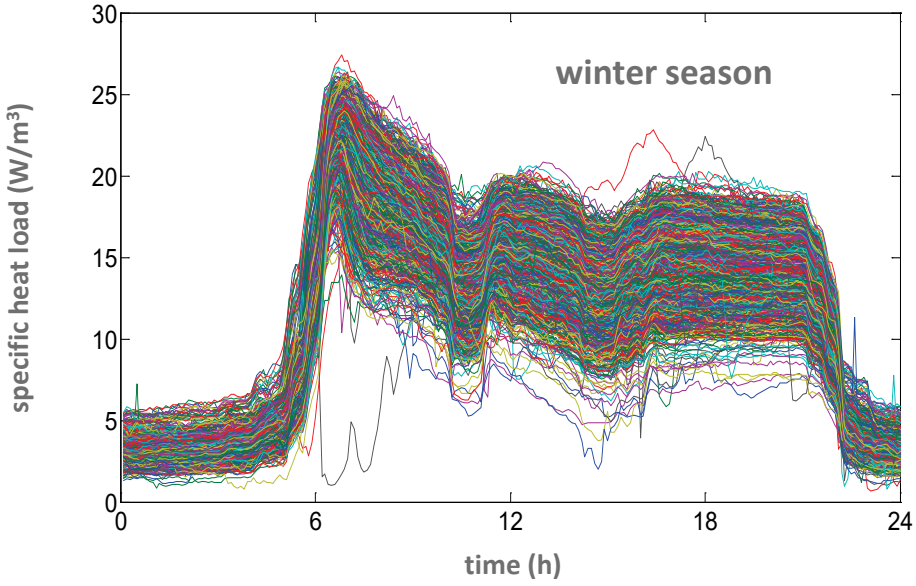
Turin District Heating heat load profile

very high peak load



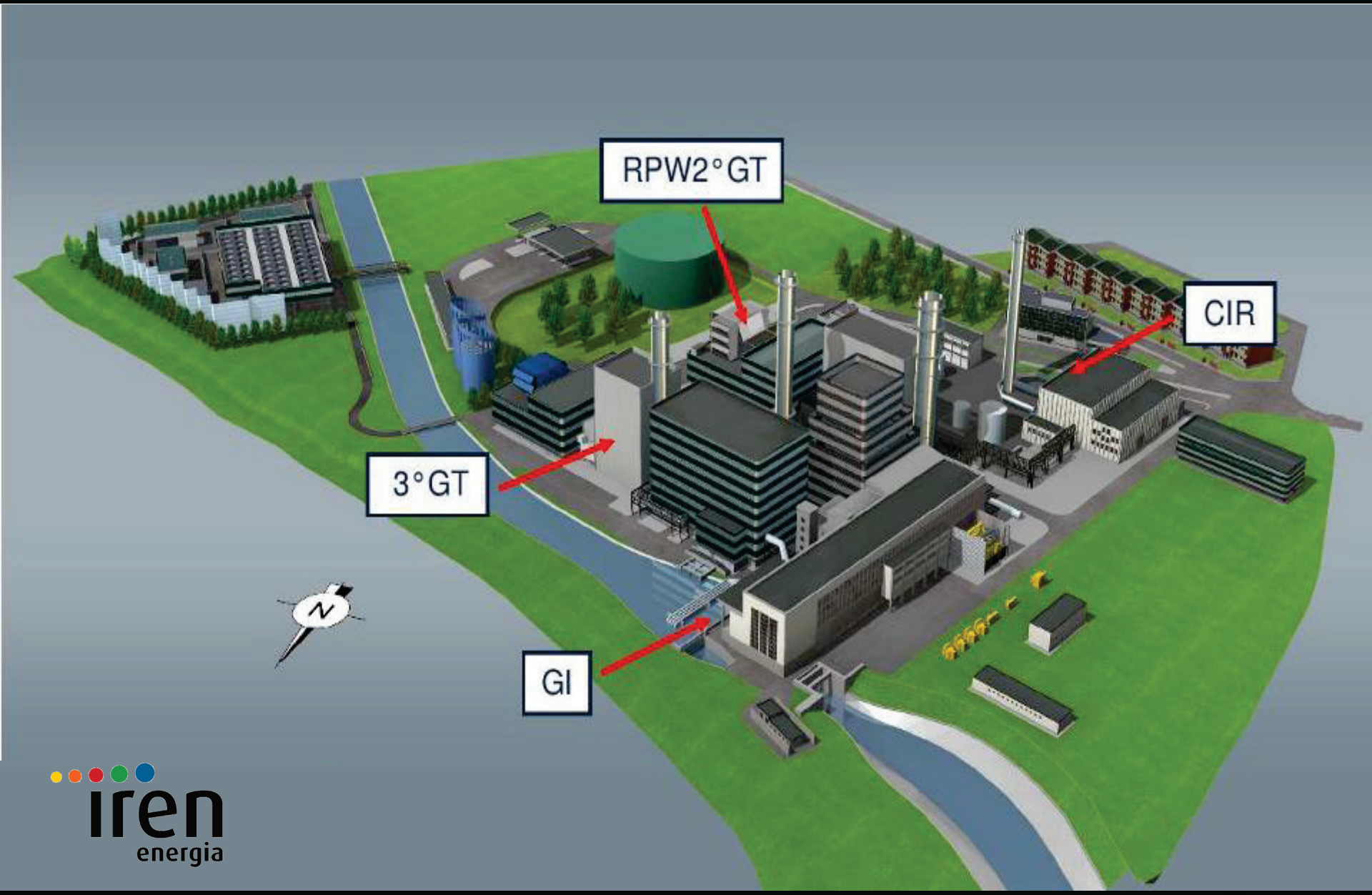
highly variable load profile





M. Noussan (2015) Wood biomass CHP in district heating systems: simulation and operation analysis, PhD thesis

Turin Combined Cycles Moncalieri

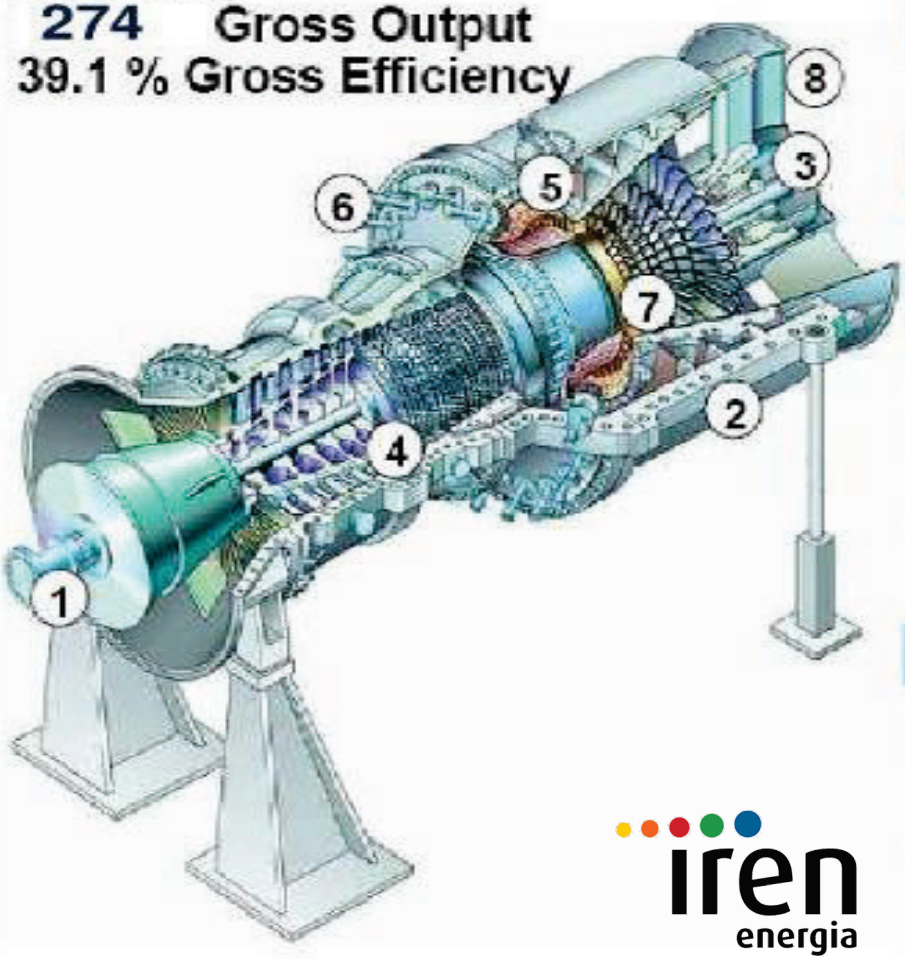


iren energia

V94.3A Gas Turbine: Design Features

ANSALDO ENERGIA

3000 rpm
274 Gross Output
39.1 % Gross Efficiency



iren energia

(1) Generator Coupling
- At cold end drive

(2) Casing
Horizontally-Split

(3) Rotor
- Two bearings
- Hollow shaft
- Disks interlocked via Hirth serrations
- Disks axially fixed via one central tie bolt

(4) Compressor
- 15-Stage
- Optimized flow distribution
- Variable inlet guide vanes

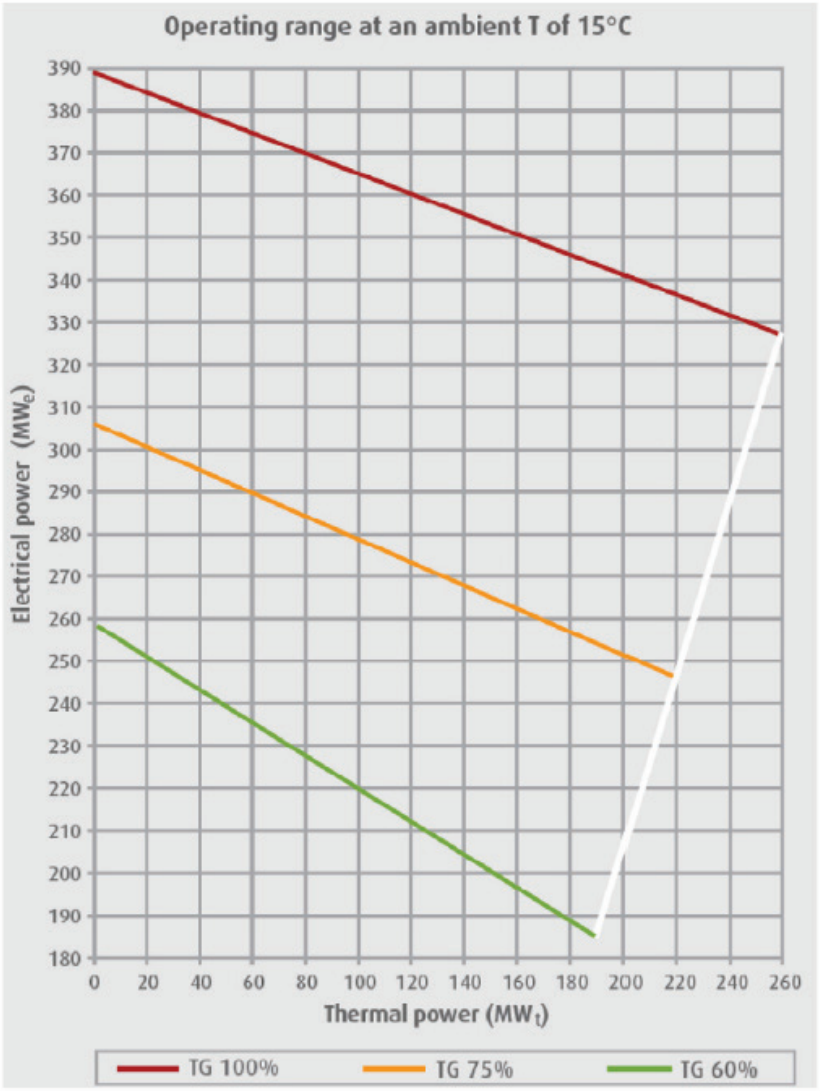
(5) Combustion System
- Annular chamber
- 24 Hybrid Burners
- Ceramic and metallic heat shields

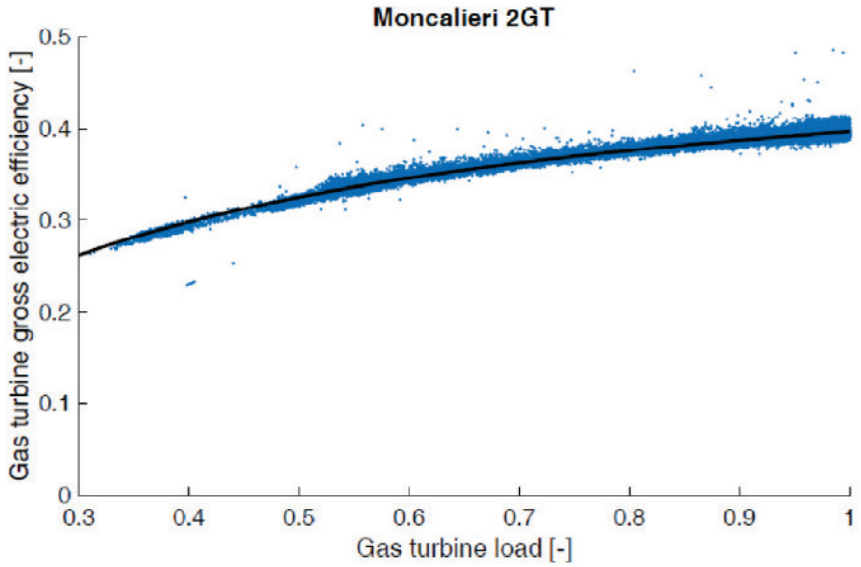
(6) Burners
- Dry low-NOx technology
- Multiple fuels capability

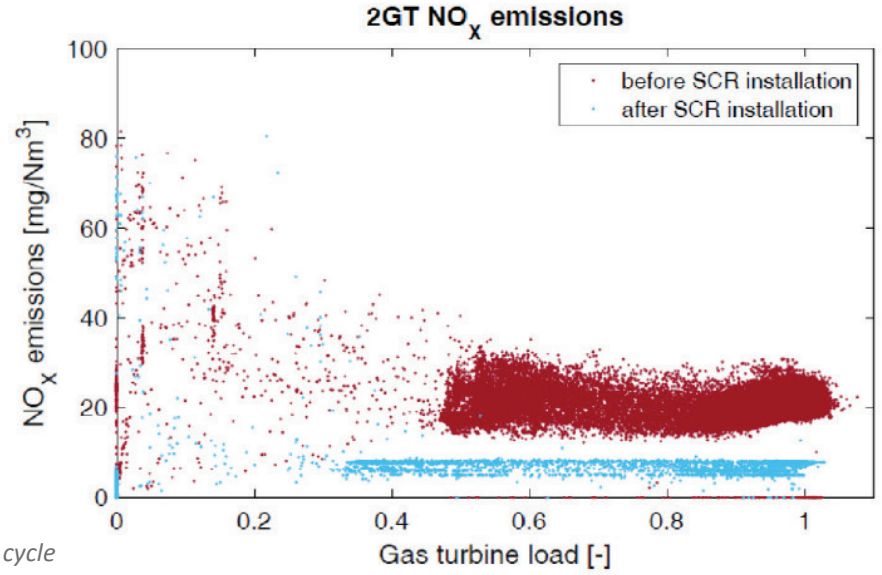
(7) Turbine
- 4-Stage
- Advanced cooling technology
- Thermal barrier blade coatings
- Film cooling of blade airfoils

(8) Exhaust
- Axial flow

Turin Combined Cycles operation flexibility



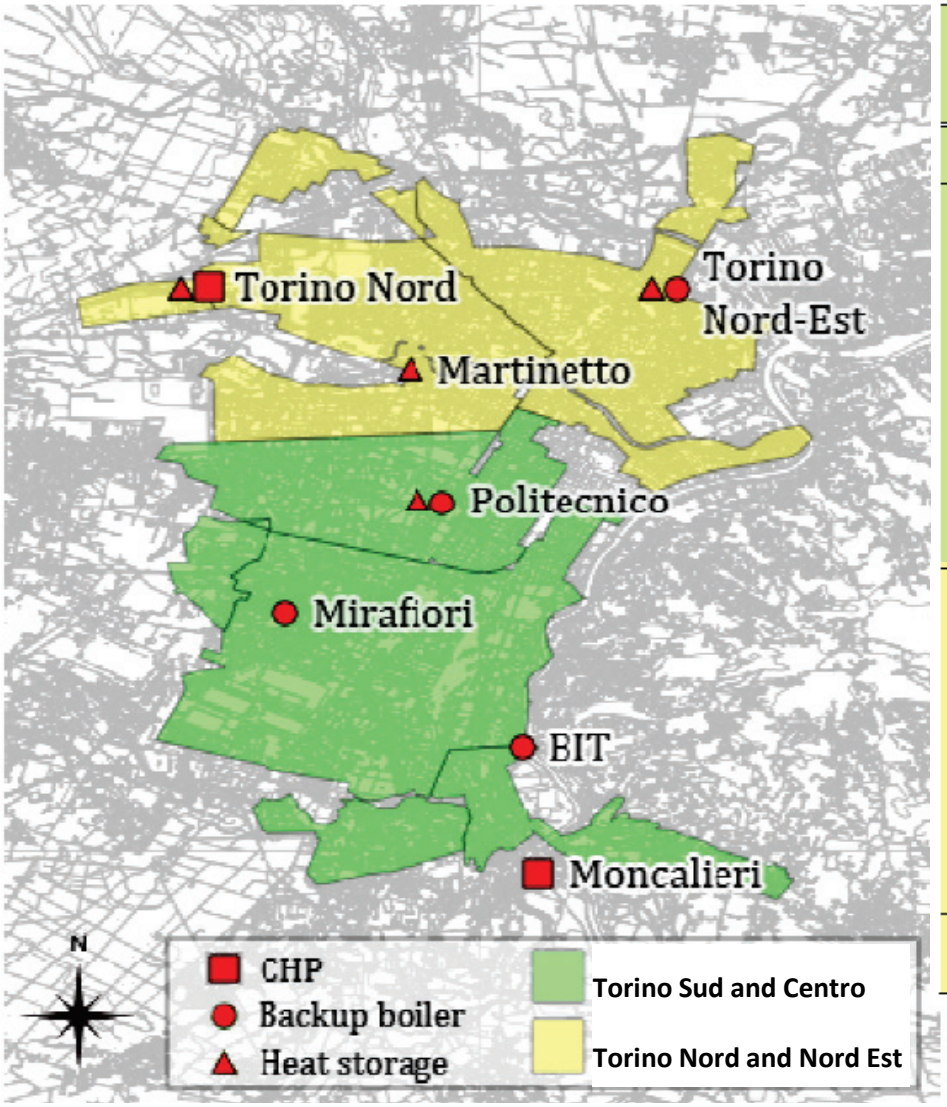




M. Jarre, M. Noussan, A. Poggio (2016) Operational analysis of natural gas combined cycle CHP plants: Energy performance and pollutant emissions, Applied Thermal Engineering

Turin Combined Cycles Torino Nord

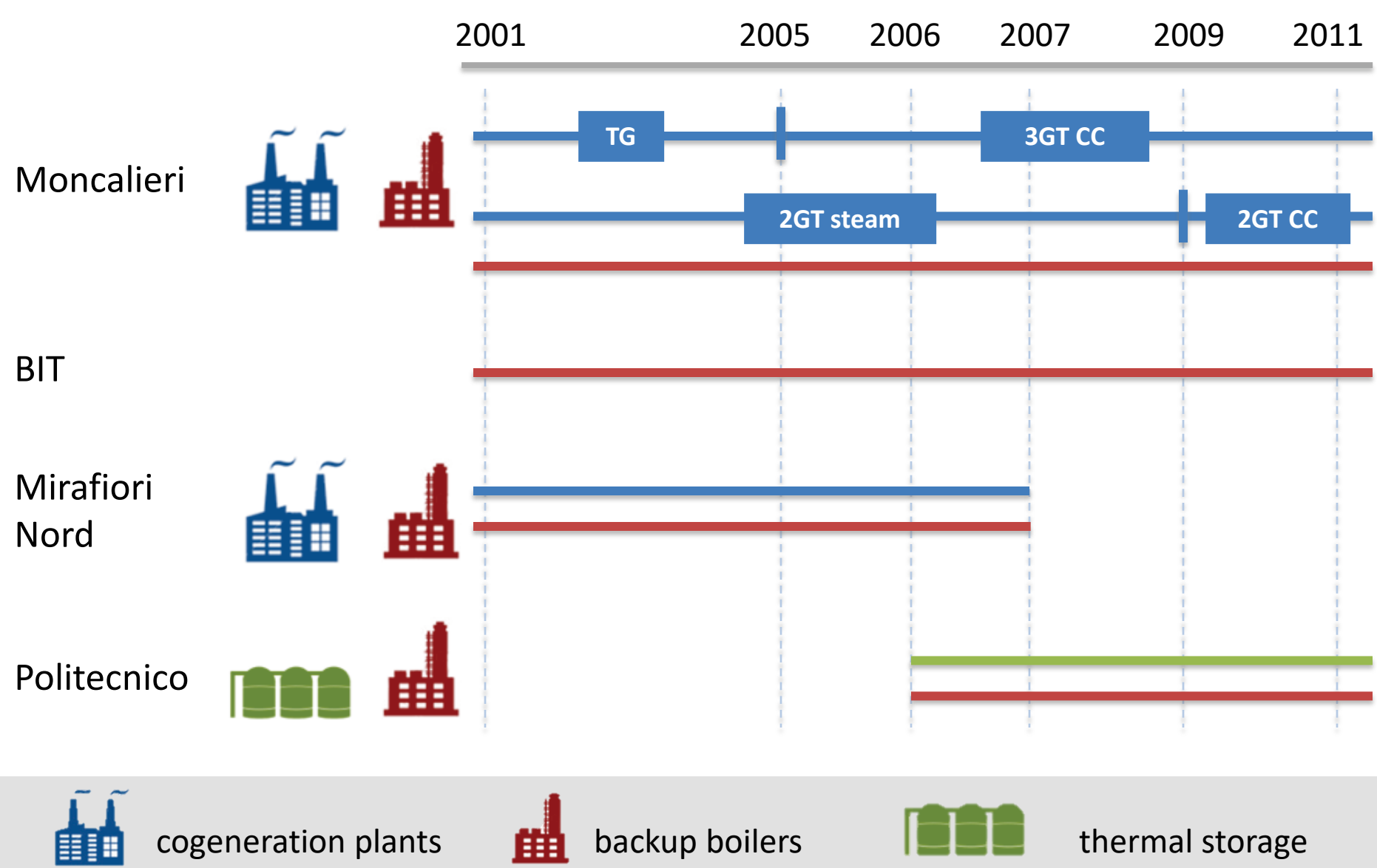
Turin District Heating generation planning



Equipment	Electrical capacity [MW_e]	Thermal capacity [MW_t]
Current situation		
Moncalieri 2GT RPW (CCGT)	395-340	0-260
Moncalieri 3GT (CCGT)	383-322	0-260
Moncalieri backup boilers	-	141
BIT backup boilers	-	255
Politecnico backup boilers	-	255
Politecnico heat storages	-	170*
Mirafiori backup boilers	-	35
Torino Nord GT (CCGT)	390-340	0-220
Torino Nord backup boilers	-	340
Torino Nord heat storages	-	340*
Torino Nord-Est backup boilers	-	270
Torino Nord-Est heat storages	-	340*
Martinetto heat storages	-	340*
Overall capacity – Current situation + Future development	**1.002**	**3.226**

G.V. Fracastoro; A. Poggio (2012) Project Profile: Turin – towards a smart energy city, Cogeneration and On-Site Power Production

Turin District Heating generation planning

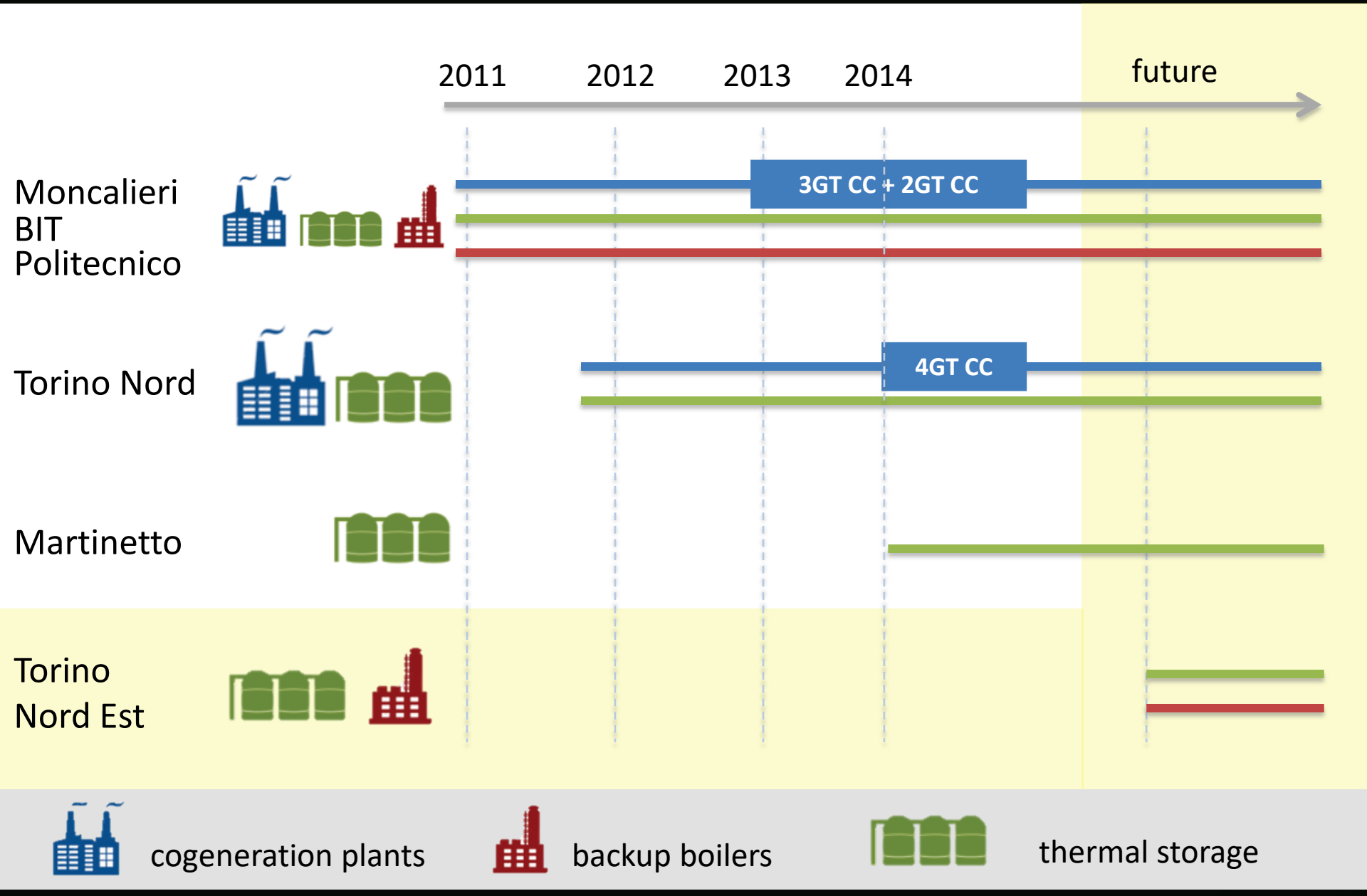


cogeneration plants

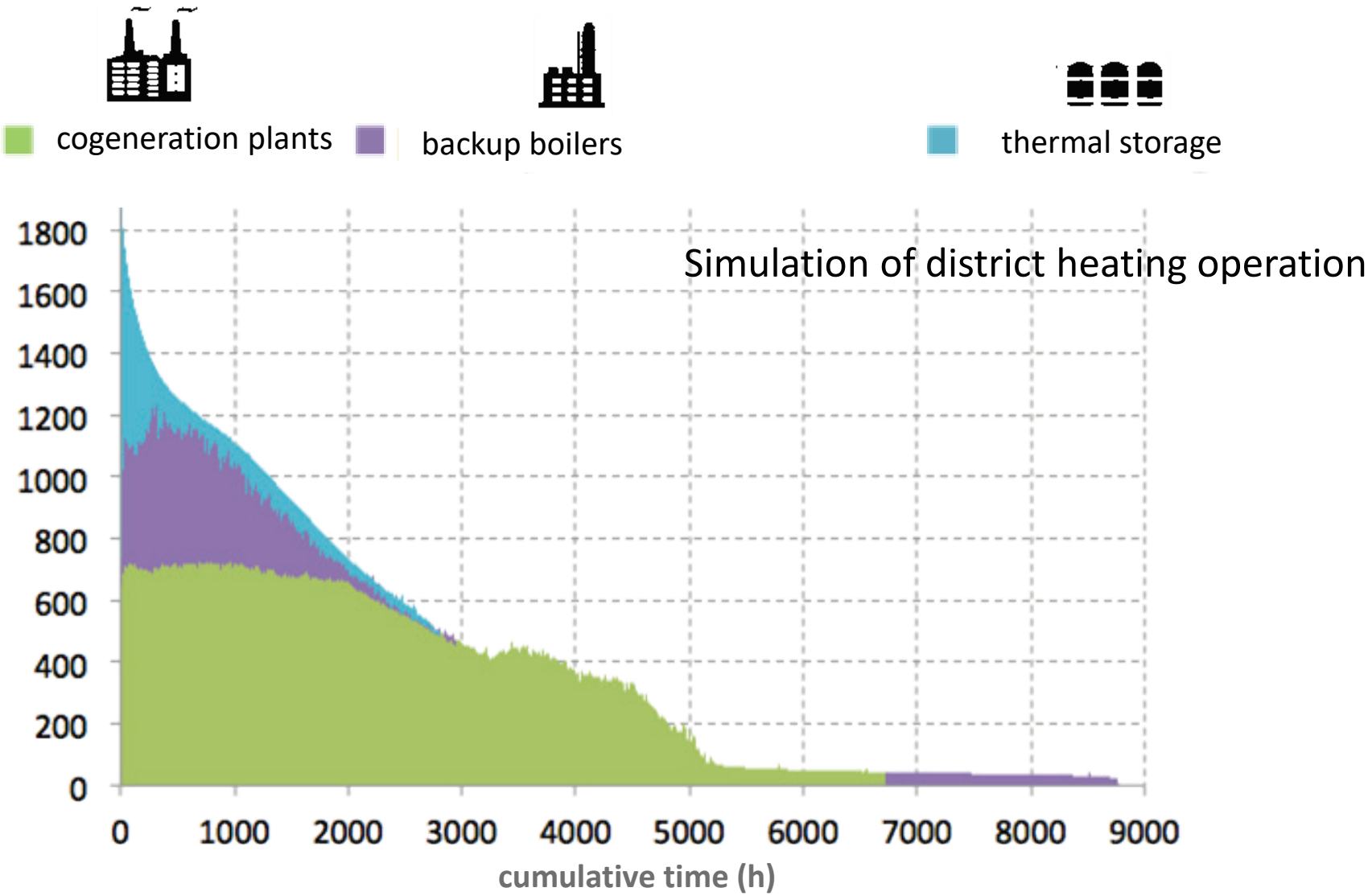
backup boilers

thermal storage

Turin District Heating generation planning



Turin District Heating generation operation



G.V. Fracastoro; A. Poggio (2012) Project Profile: Turin – towards a smart energy city, Cogeneration and On-Site Power Production

2050 EU Long term strategy

EUROPEAN COMMISSION

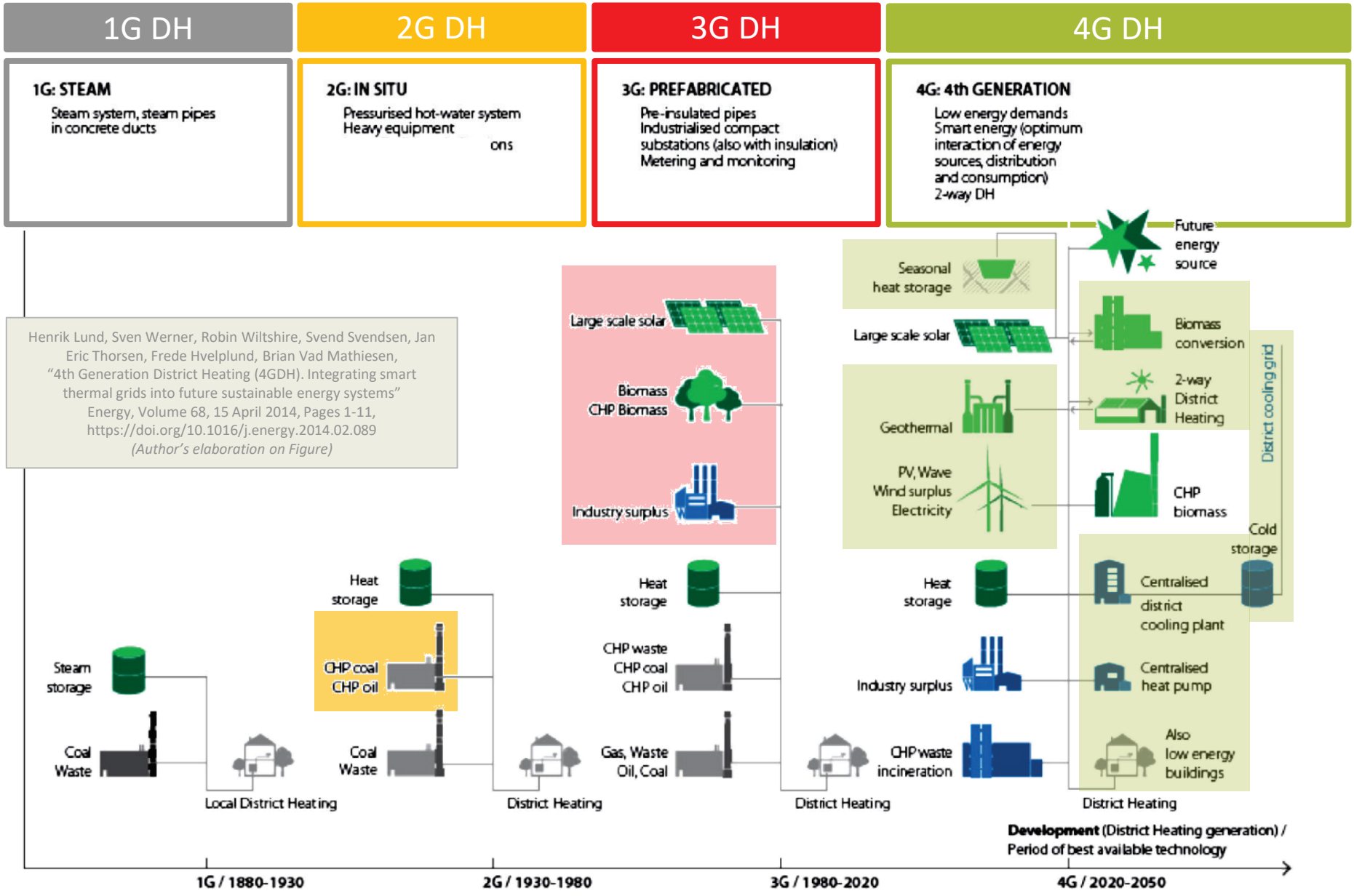
IN-DEPTH ANALYSIS IN SUPPORT OF THE COMMISSION COMMUNICATION COM(2018) 773

Brussels, 28 November 2018

"Likewise, district heating and cooling networks have a demonstrated potential to help deliver a wide range of renewable energy sources, including surplus renewable electricity, into buildings, particularly in cities. The switch to district heating would require dedicated infrastructure and sectoral integration and the district heating sector would need to become increasingly efficient and decarbonised. District heating and cooling systems currently supply about 10% of EU's heating and cooling demand but there is a potential to expand them to supply 50% of the heat demand, with 25–30% of the heat potentially supplied using large-scale electric heat pump. Innovations in low-temperature, more efficient district heating and cooling infrastructure could even further expand the potential use of low-carbon options."

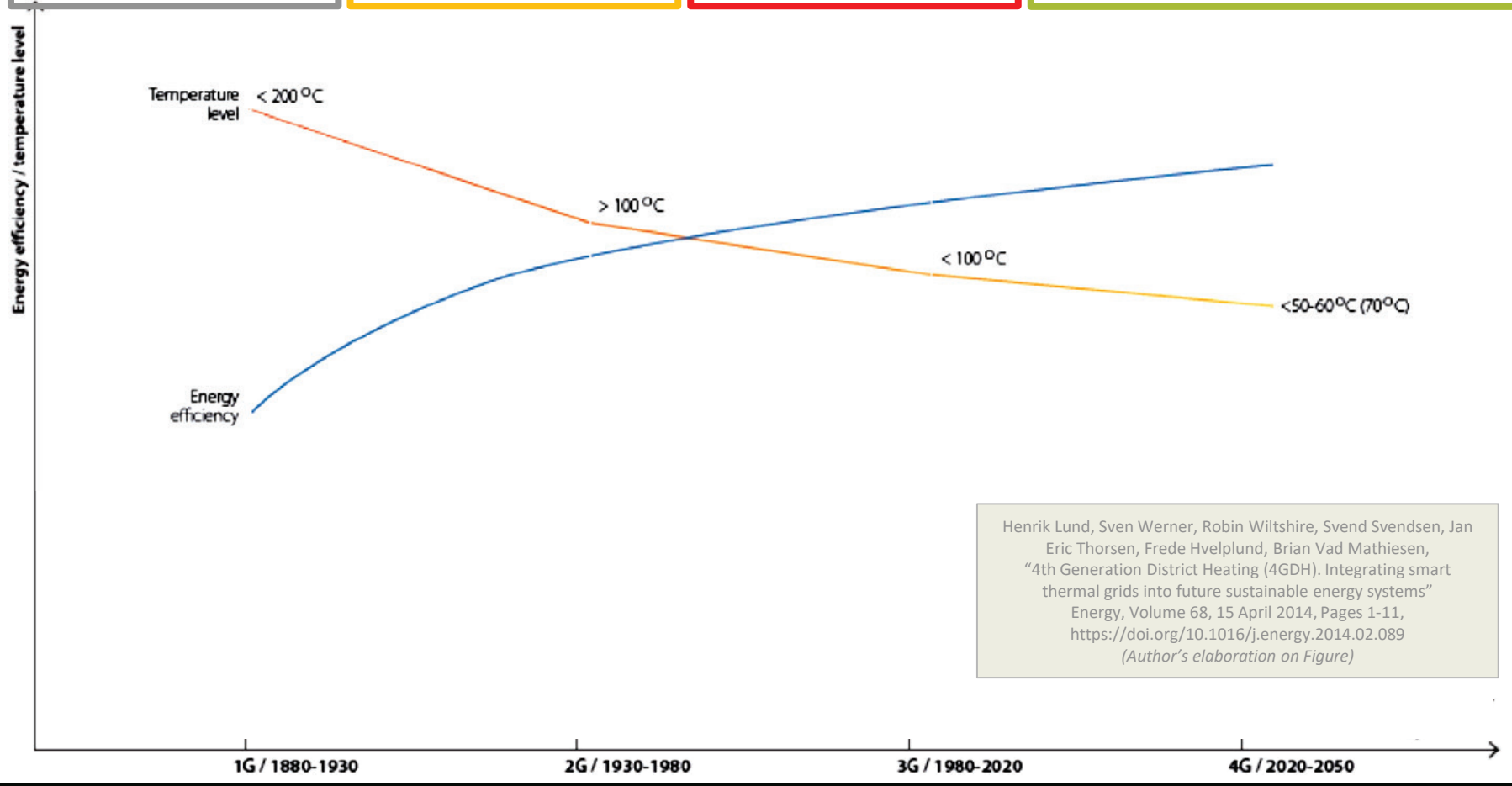
(4.3.1.3 Fuel switch in heating and cooling, pag. 95)

2050 district heating evolution



2050 district heating evolution

1G DH	2G DH	3G DH	4G DH
1G: STEAM Steam system, steam pipes in concrete ducts	**2G: IN SITU** Pressurised hot-water system Heavy equipment Large "build on site" stations	**3G: PREFABRICATED** Pre-insulated pipes Industrialised compact substations (also with insulation) Metering and monitoring	**4G: 4th GENERATION** Low energy demands Smart energy (optimum interaction of energy sources, distribution and consumption) 2-way DH



Henrik Lund, Sven Werner, Robin Wiltshire, Svend Svendsen, Jan Eric Thorsen, Frede Hvelplund, Brian Vad Mathiesen, "4th Generation District Heating (4GDH). Integrating smart thermal grids into future sustainable energy systems" Energy, Volume 68, 15 April 2014, Pages 1-11, https://doi.org/10.1016/j.energy.2014.02.089 *(Author's elaboration on Figure)*

REGIONE PIEMONTE

SHREC - Energy policies and innovative projects in Piemonte

21st of January 2021 - online workshop

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Integrated District Heating System in Torino and its potential development

… grazie per l'attenzione

POLITECNICO DI TORINO
Dipartimento Energia «Galileo Ferraris»

Alberto POGGIO
Sistemi per l'Energia e l'Ambiente

[research]
growing resilience