Geothermal hybrid plant ..
..and more…

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Geothermal Innovation & Sustainability
Enel Green Power

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Geothermal technologies

Binary plants

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Geothermal technologies

Binary plants

Heat Ex

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Geothermal technologies

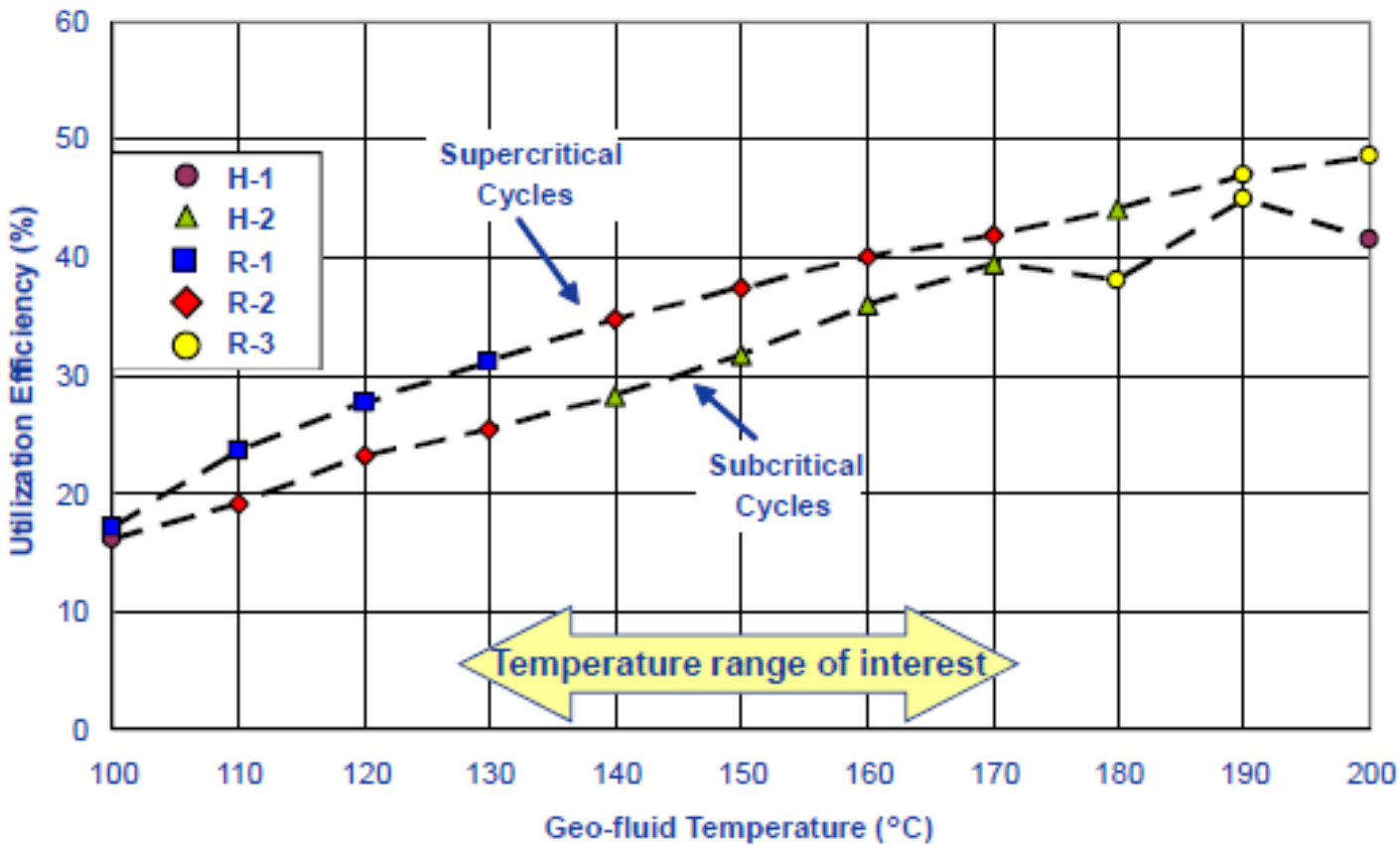
Binary plants – supercritical fluids

Experimental campaign – ORC power plant prototype realization

- **COD 20-3-2012**
- **Calibration and initial performance tests**
- **August: final set up with improvement in heat exchangers**
- **Long run test**
- **Performance tuning with manufacturer**
- **Preliminary results are promising**

Geothermal technologies

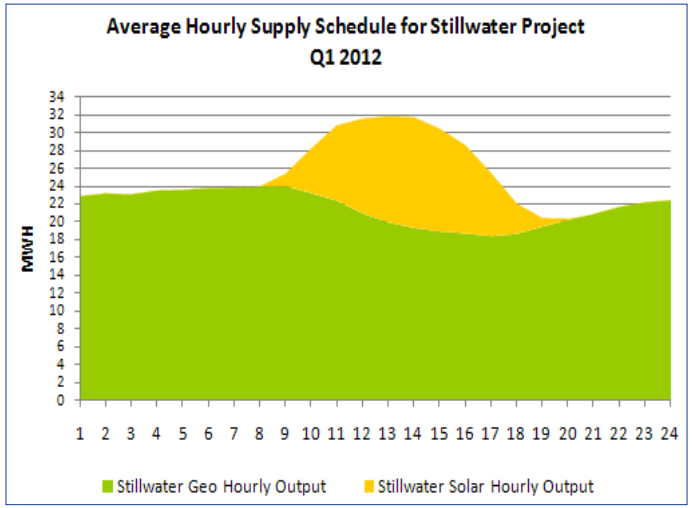
Binary plants - supercritical fluids



Supercritical cycles provide higher utilization efficiency for all geo-fluid temperature range, resulting in max 23% increase in net power

Geothermal technologies

Hybrid plants - PV



- World's first solar/geothermal hybrid project combines the continuous generation capacity of the medium enthalpy geothermal binary cycle with the peak capacity of solar power thus allowing for synergies to be explored.
- Integrates 26 MW of solar photovoltaic capacity to EGPNA's operating 33 MW Stillwater Geothermal Project
- Consists of over 89,000 polycrystalline silicon PV panels built on 240 acres. It will generate enough energy to meet the needs of 16,000 American households.
- In 2012, this state-of-the art plant won EGPNA the Geothermal Energy Association Honor Award for Technology Advancement which recognizes companies that develop innovative or pioneering technology to further geothermal development.

Stillwater Solar Geothermal Hybrid Project

Geothermal technologies

Hybrid plants - PV

> **Enel Green Power Joins Forces with Sharp & STMicroelectronics**

Enel Green Power, Sharp, and STMicroelectronics have joined forces to produce innovative thin-film photovoltaic panels. The new facility is the largest PV production facility in Italy and one of the largest in Europe. It is expected to have an initial production capacity of 160 MW annually, which is expected to grow to 480 MW. Enel Green Power and Sharp signed an additional agreement to jointly develop solar plants in the Mediterranean, with the objective of developing 500 MW of solar capacity by the end of 2016. In March of 2012 five new projects were launched by ESSE—the equal share joint venture between Enel Green Power and Sharp.

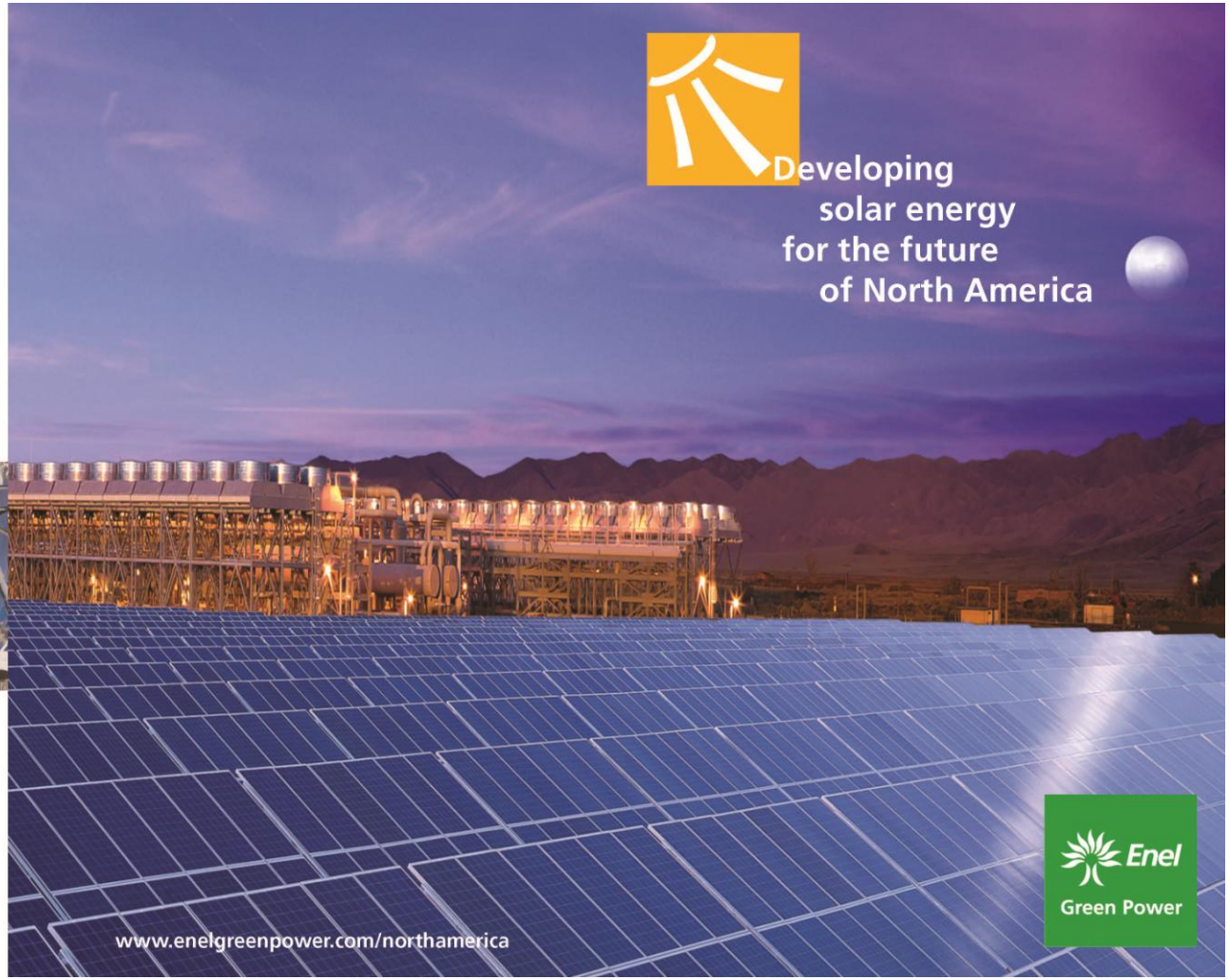
"The demand for solar in the United States is at an all-time high. In the first quarter of 2012, developers installed 85 percent more solar panels compared to the first quarter 2011. Total U.S. installations may reach 3,300 MW this year, which would make the country the fourth largest solar market in the world."

* source: U.S. Department of Energy

Renewable Energy Expands

The role played by the renewable energy sources for a sustainable and competitive future is understood and shared by institutions both in North America and globally, with dedicated investment programs and development incentives. The greatest scope for increasing the use of renewables in absolute terms lies in the power sector.

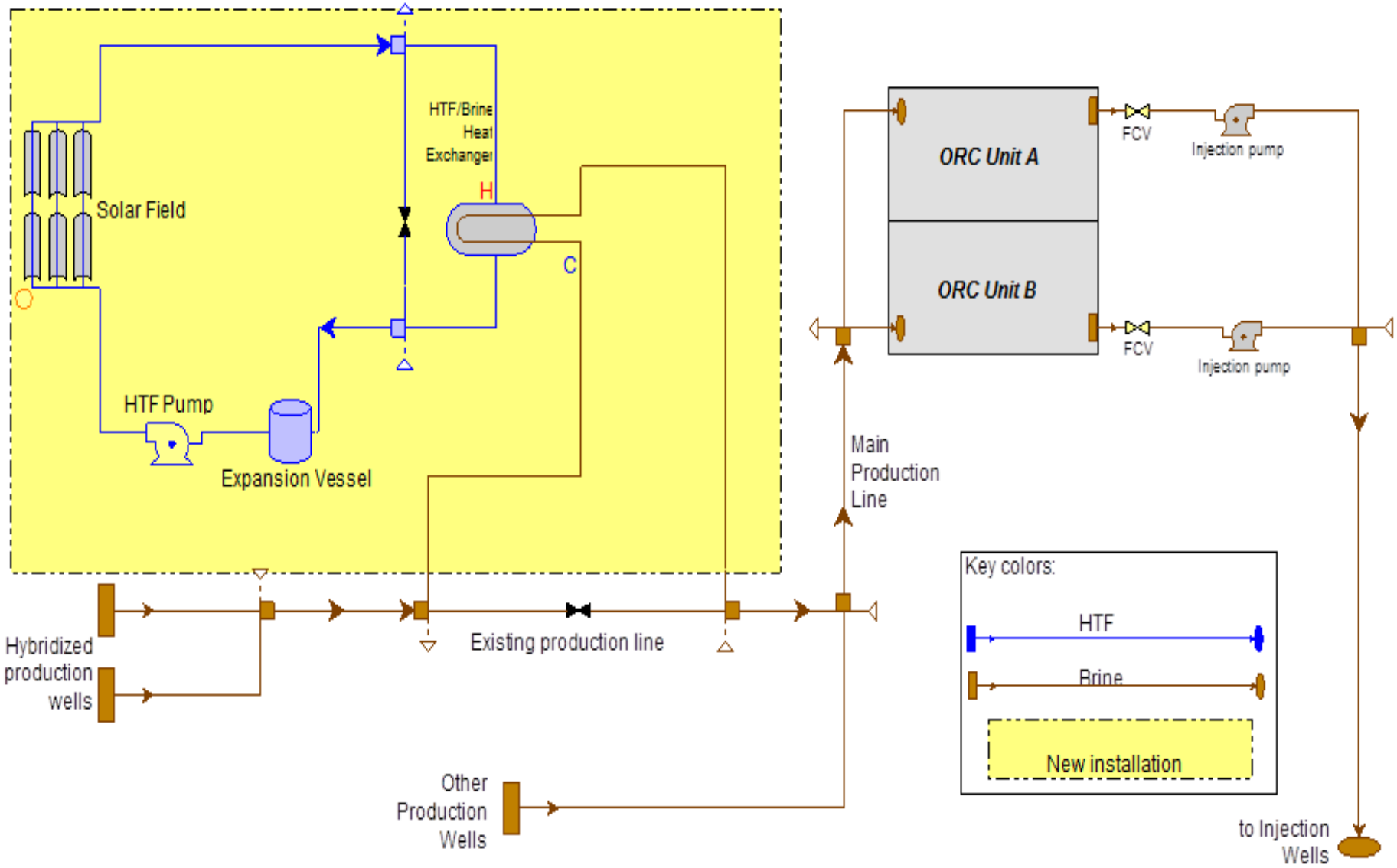
According to the Solar Energy Industries Association (SEIA), solar is already the fastest growing energy sector in the U.S. and by 2014 it will likely be the largest source of new electric capacity in America and the world's largest solar market.



Stillwater Solar Geothermal Hybrid Project

Geothermal technologies

Hybrid plants Solar CSP



Geothermal technologies

Hybrid plants Solar CSP

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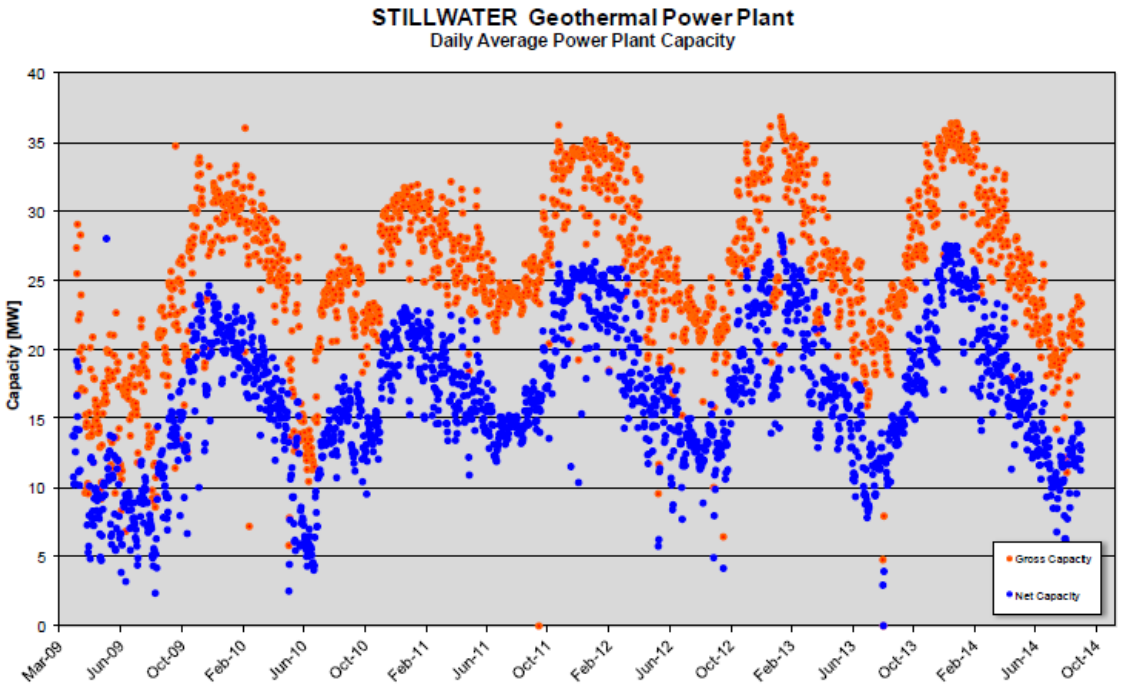
Figure 1 – flow measurement with the ultrasonic flow meter

Geothermal technologies

Hybrid plants – Solar CSP



Years	Total Gross Generation [GWh]	Total Net Generation [GWh]
2009	124.323	71.815
2010	217.458	130.461
2011	242.086	159.271
2012	235.711	155.553
2013	236.881	157.975
2014 (Jan – Aug)	149.164	95.343

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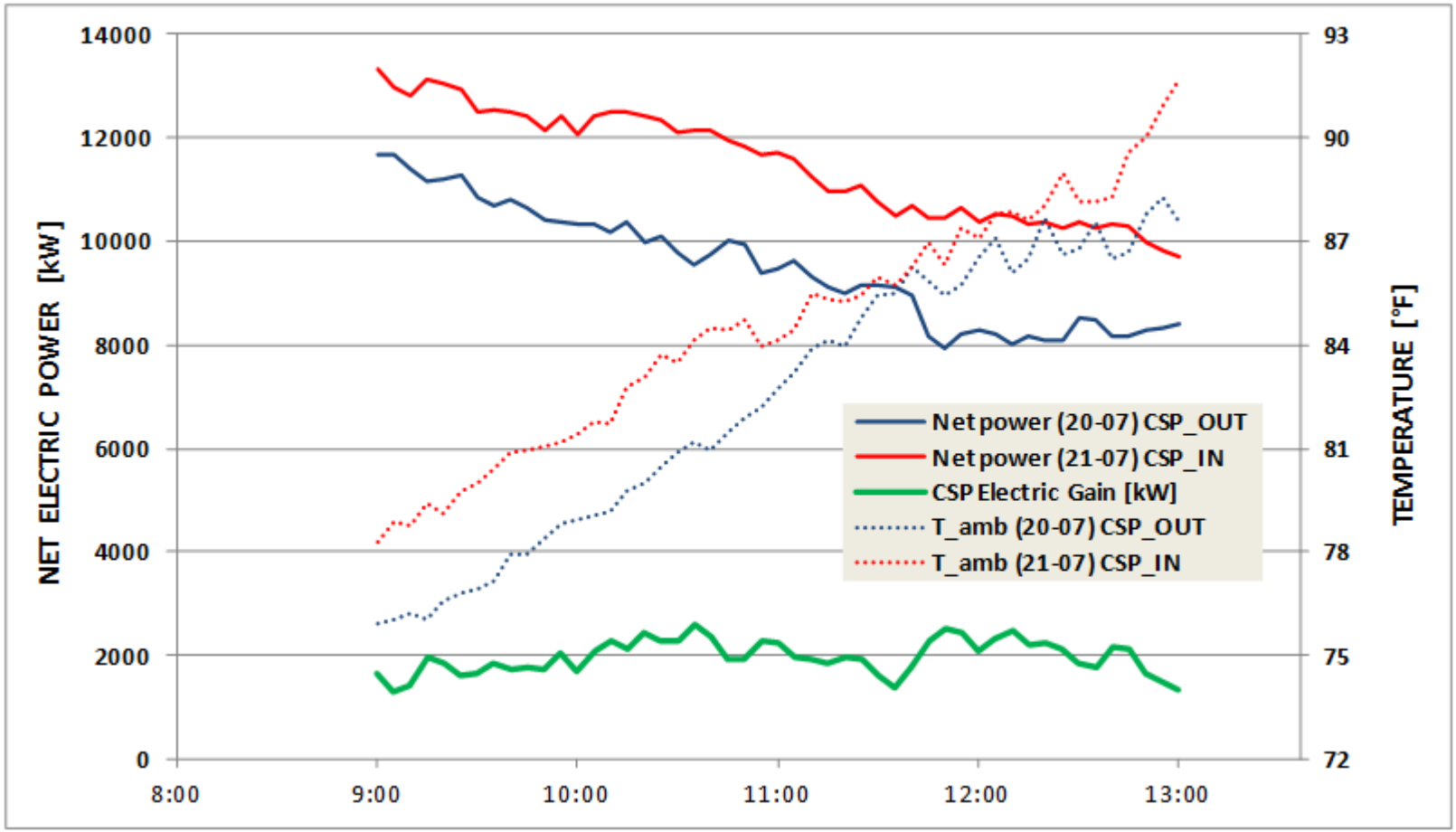
Hybrid plants – Solar CSP



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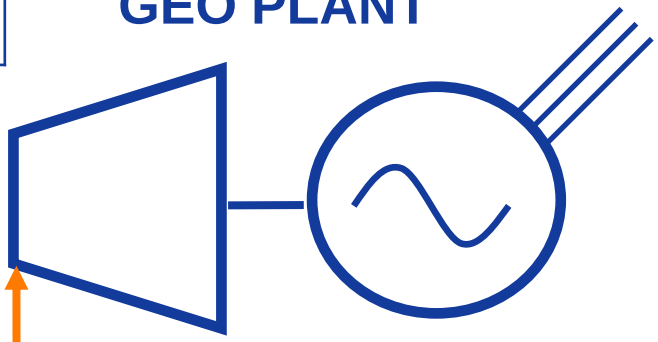
Geothermal technologies

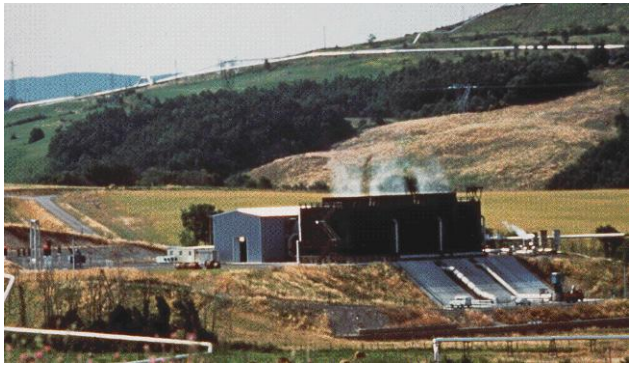
Hybrid plants - Biomass

STEAM FROM THE WELLS

Site	Technology	Biomass type	Biomass need [kt/y]	Capacity [MWe]
Cornia 2	Geothermal steam superheater with biomass firing by combustion grate	Forest & agricultural residues, power crops	43	4.8

GEO PLANT





Geothermal technologies

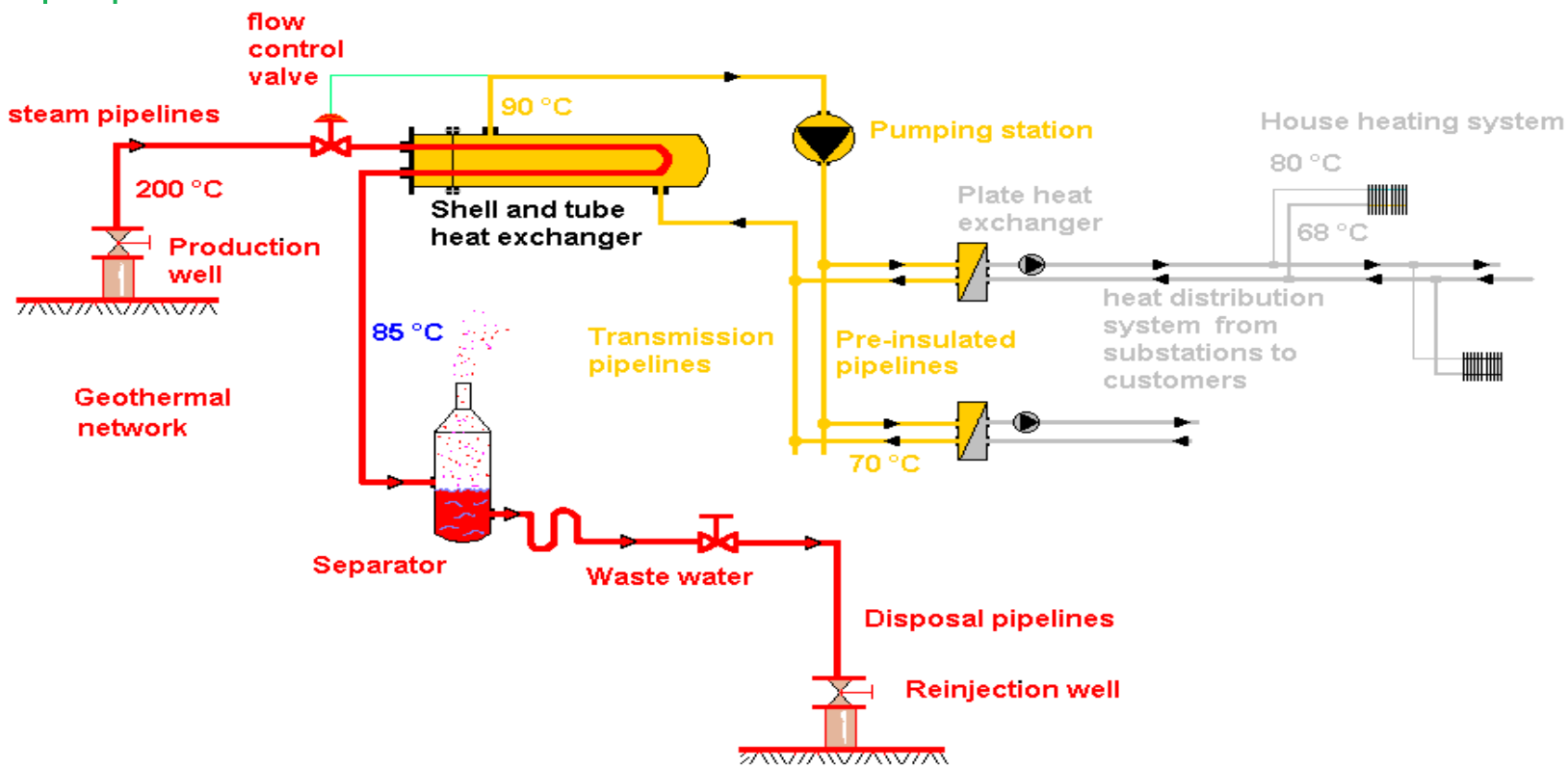
Hybrid plants - Biomass

ENEL GREEN POWER BRINGS ONLINE WORLD'S FIRST INTEGRATED GEOTHERMAL AND BIOMASS PLANT IN TUSCANY

The new 5 MW facility is expected to increase the geothermal plant's output by more than 30 GWh per year while avoiding the annual emission of over 13,000 tonnes of CO_2. There will also be a substantial impact on employment, with an additional 35 to 40 direct and indirect jobs in sourcing the local biomass being generated. Other benefits include the efficient use of agricultural and agro-industrial by-products, the optimal maintenance of forest resources with the consequent reduction in hydrogeological risk, the sustainable development of energy crops and the production of significant levels of cogenerated heat.

Geothermal technologies

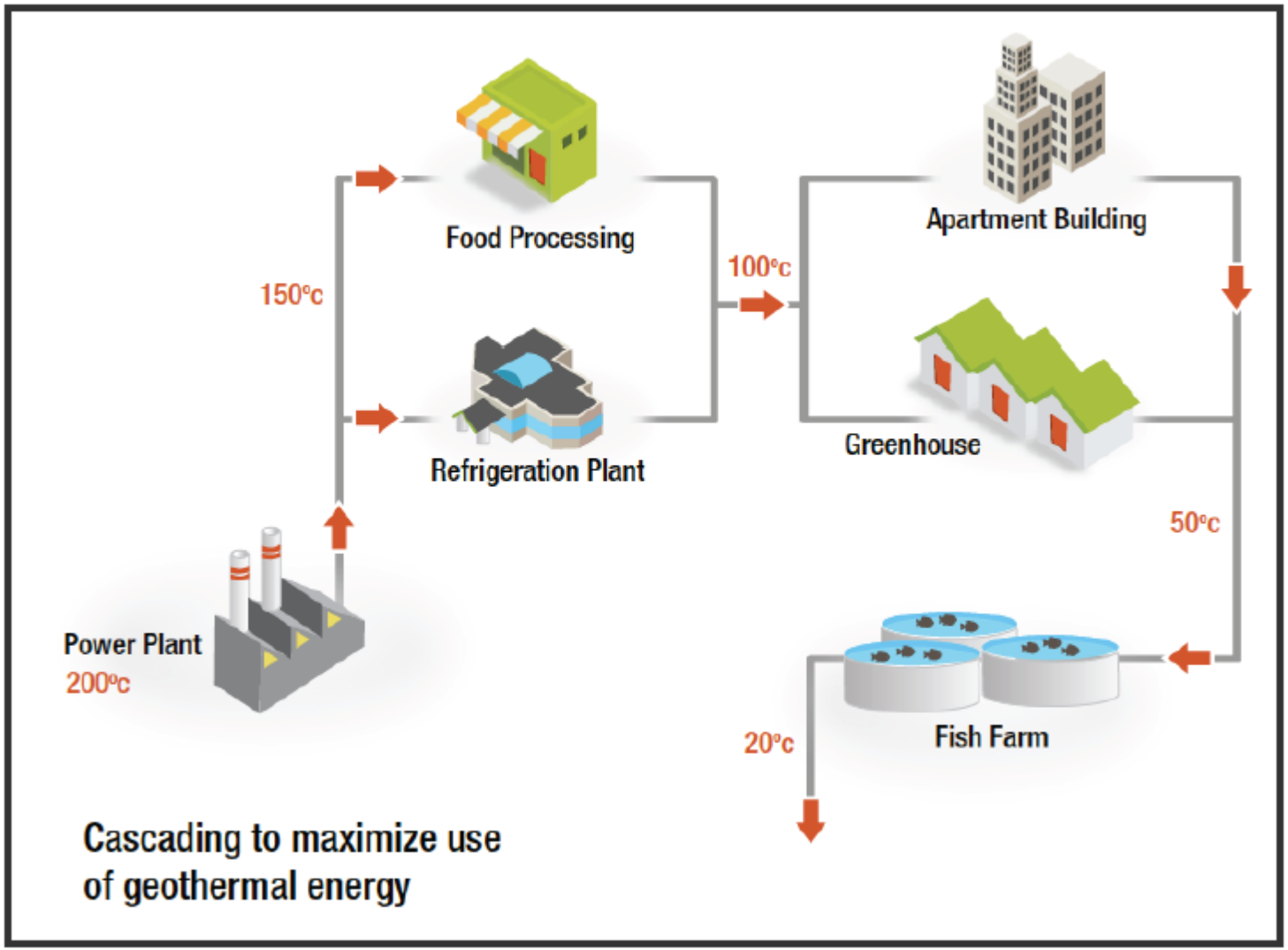
Cogeneration plants



→ District Heating system

Geothermal technologies

Cogeneration plants



→ Cascade Utilizations

THANKS FOR YOUR KIND ATTENTION