Growing Smart Energy Cities

Integrative energy planning for growing cities from a private-economic perspective

VATTENFALL

Hanno Balzer, June 2017

VATTENFALL AT A GLANCE

- One of Europe's largest producers of electricity and heat
- 100% owned by the Swedish state
- Main products: electricity, heat, gas, energy services
- Main markets are Sweden, Germany, Netherlands, UK, Denmark and Finland
- 20,000 employees

Net sales in 2016: SEK 139bn

Underlying operating profit[1] in 2016: SEK 22bn

VATTENFALL IN TRANSITION: POWER CLIMATE SMARTER LIVING

"At Vattenfall we exist to help all of our customers power their lives in ever climate smarter ways and free from fossil fuel within one generation"

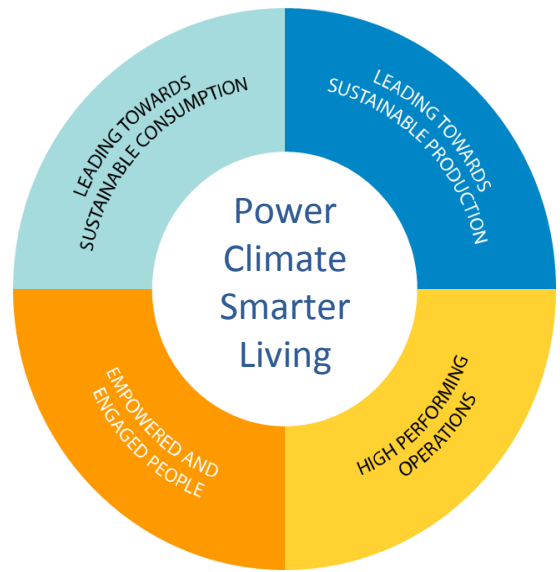
VATTENFALL STRATEGY

Our story:
"At Vattenfall, we exist to help all of our customers power their lives in ever climate smarter ways and free from fossil fuel within one generation"

+

Four beliefs about the future:

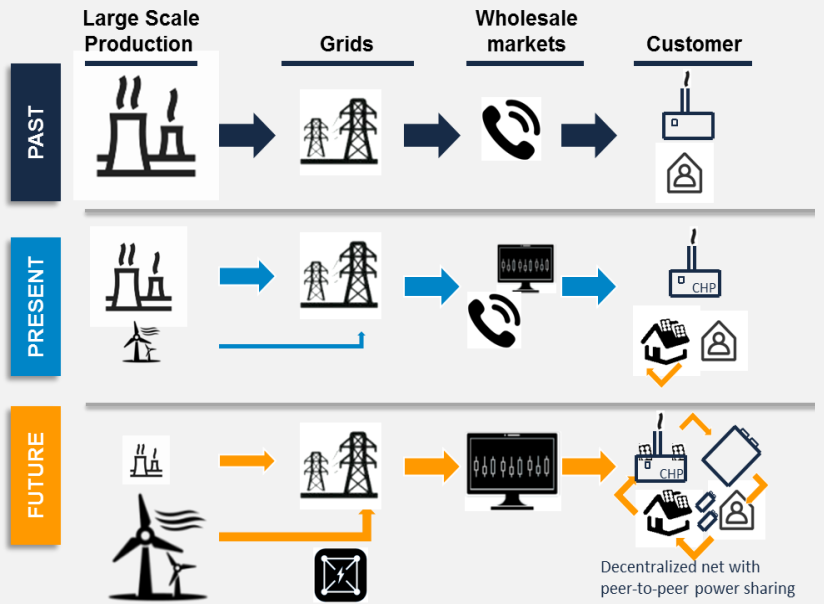
1. Customer centricity and sustainability will be key to attracting customers, talent and investors
2. Further electrification will be a key enabler for reducing CO2 emissions
3. The future energy system will consist of both central and decentralised energy solutions
4. Lean operations is a prerequisite for value creation and growth



WHAT DOES THAT MEAN FOR OUR PORTFOLIO?

The future energy system will consist of both central and decentral energy solutions

- Technology trends drive penetration of renewable and decentralised generation and new types of energy storage
- Digitalisation will make a more complex system work
- Change often happens faster than incumbents expect



CHALLENGES OF THE GERMAN HEAT MARKET

Digitalisation

- Standardisation of communication
- Steering of energy consumption and energy production
- Growth of independent players in the market

CO_2-Neutrality

- German government requires to double the rate of modernization, replace existing plants by modern, innovative and efficiently plants
- Increasing requirements by law (EnEV and EEWärmeG)
- Decentral energy solutions are part of the energy turnaround

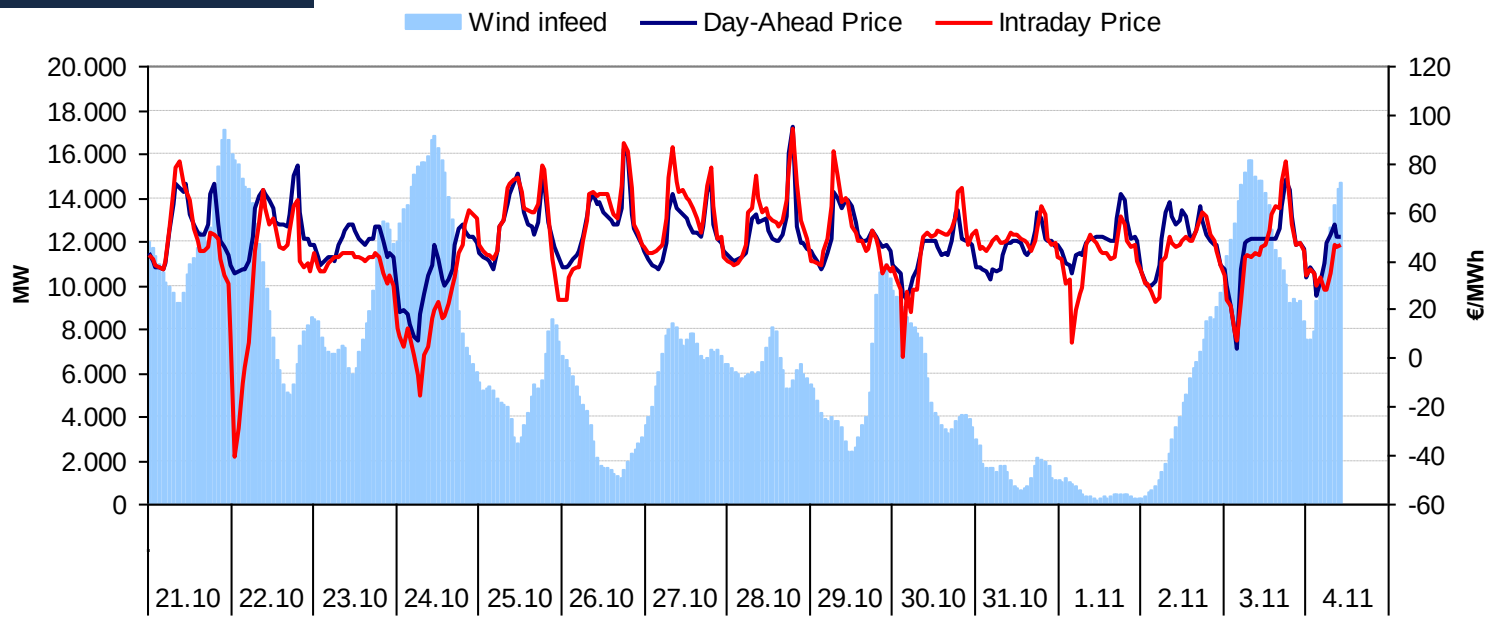
Combination of Heat and Power

- Storage capacity at a recent price
- „new“ technologies
- Market size of heat and power

CENTRAL EUROPE: THE SPOT-MARKET IS DRIVEN BY THE WIND INFEED

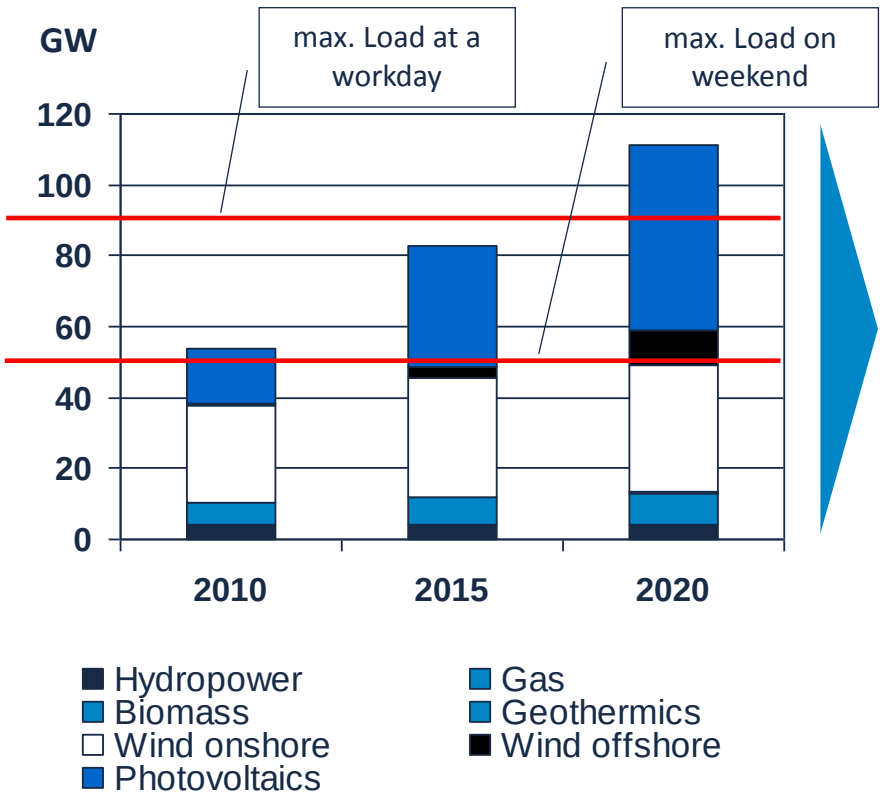
Spot Price Development vs. Wind infeed

VC Portfolio Report Week 43 (02.11.2010) – Market Development



… that drives the demand for (cheap) storage capacities

GERMAN NATIONAL ACTIONPLAN FOR RENEWABLES INCLUDES MASSIVE GROWTH IN INSTALLED CAPACITY!



Quelle: Aktionsplan der Bundesregierung

Transformation of the power generation system in near future

- less ‚controllable' production
- increasing volatility

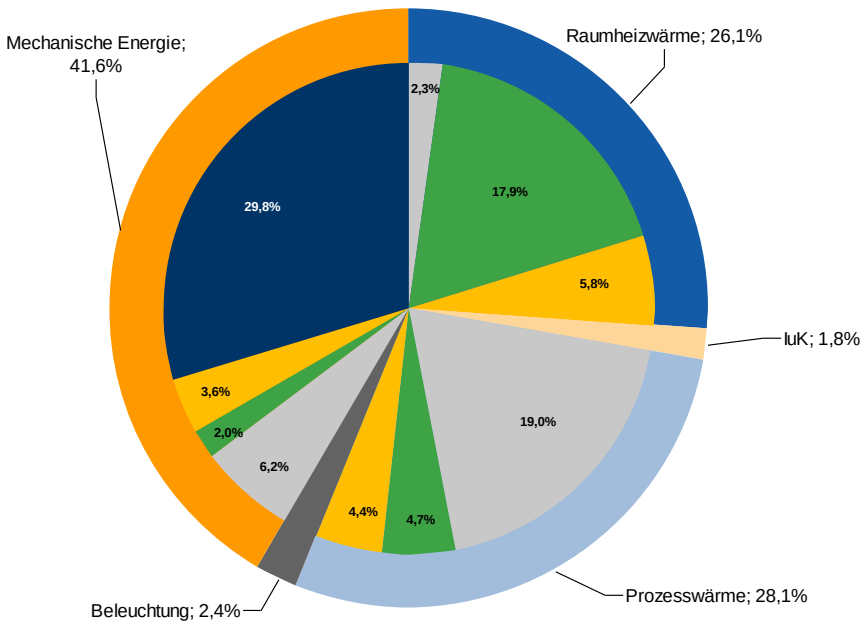
Political requirement for increasing CHP-production

- CHP still follows **heat demand**

Crucial question:

Does an **innovative combination** of those two complex challenges lead to an improved situation ?

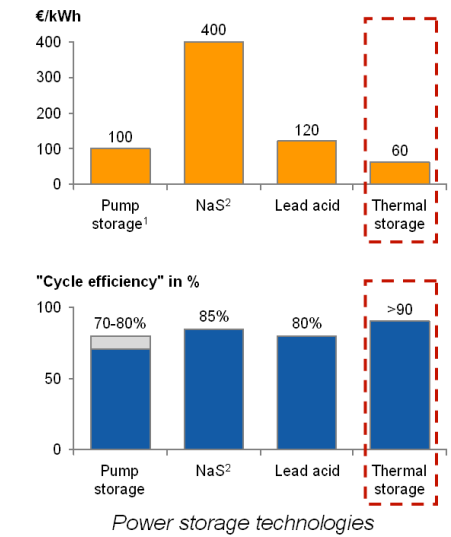
ENERGY CONSUMPTION IN GERMANY & COSTS OF ENERGY STORAGE



Draft – 6 July 2011

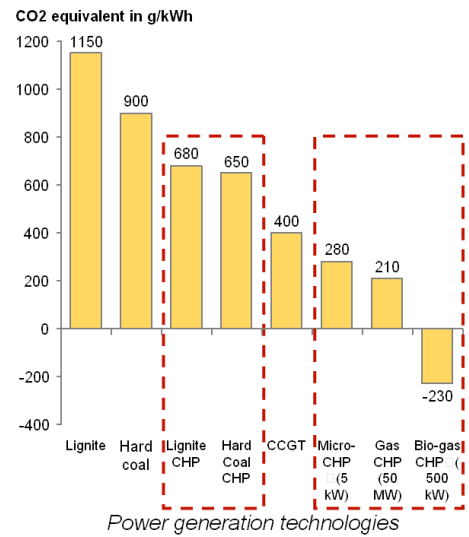
Heat storage is readily available and cost efficient technology to provide balancing

Thermal storage with large advantages as compared to electricity storage...



Power storage technologies

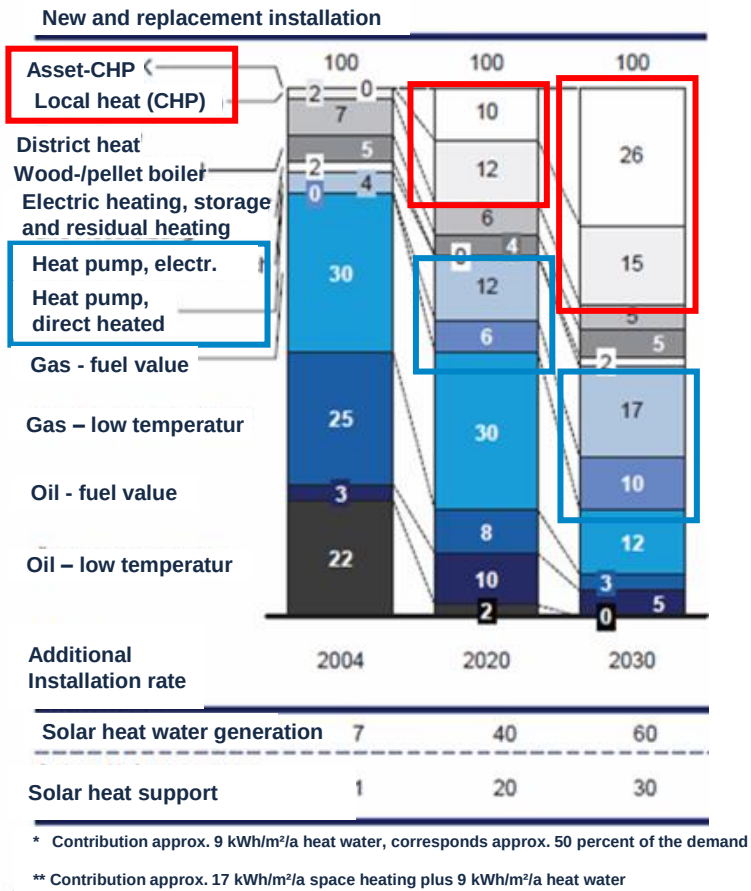
... as well as regarding CO2 emissions



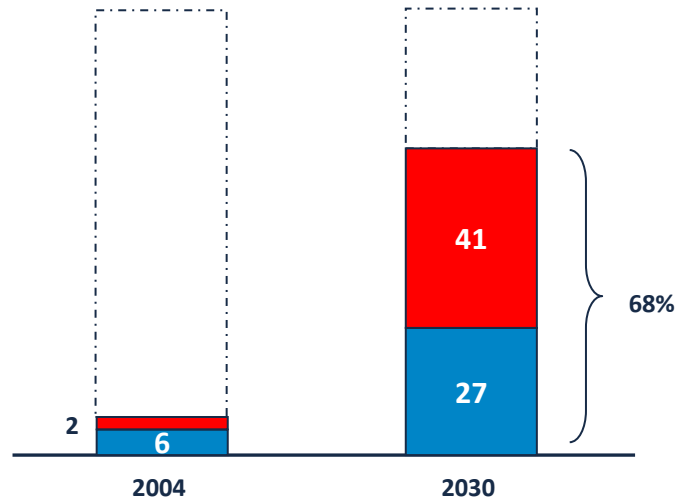
Power generation technologies

The Heat market is the biggest single Market and contents a lot of cheap storage capacity

DEVELOPMENT OF THE HEATING STRUCTURE IN GERMANY (2004-2030) …

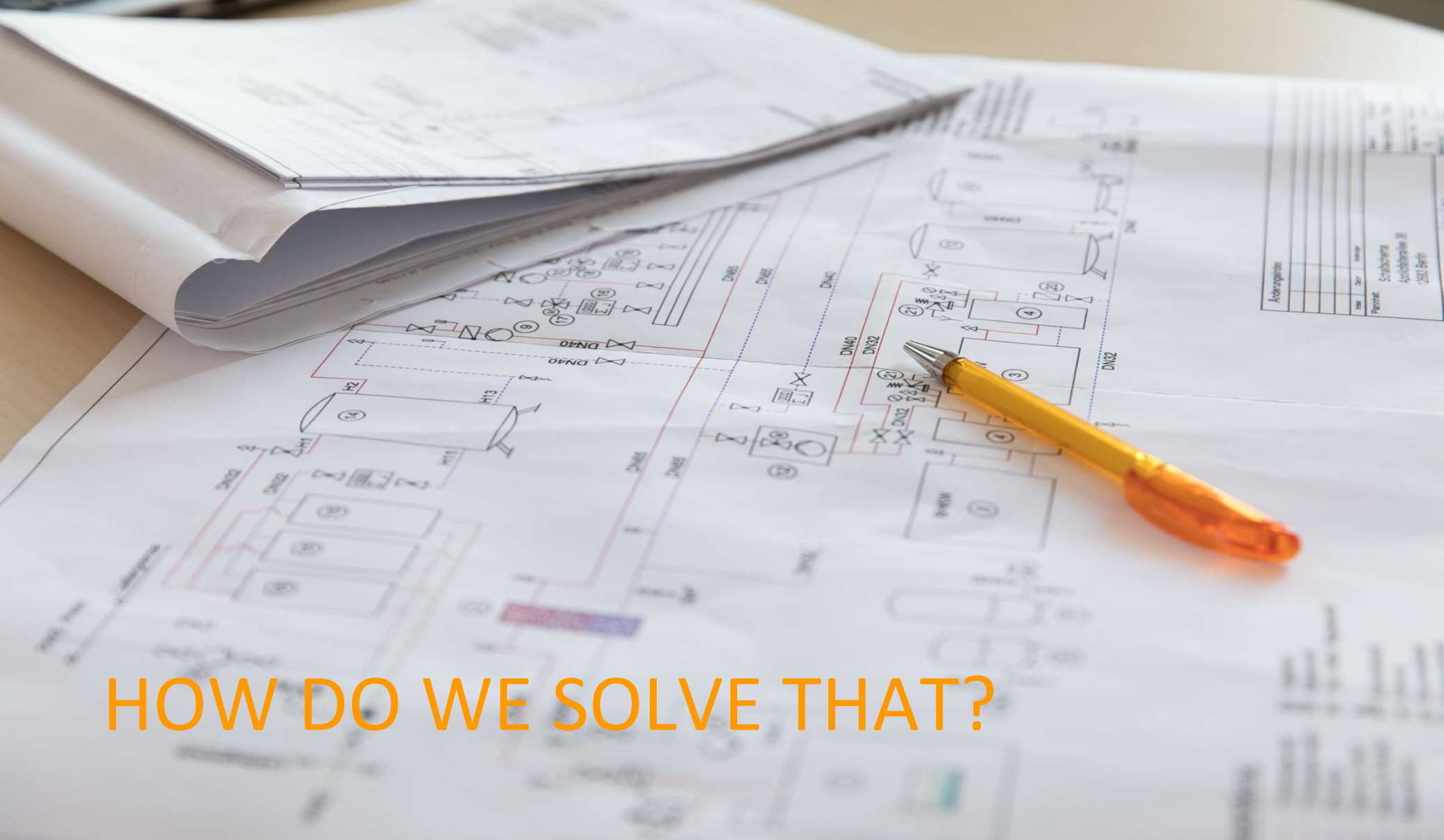


Source: Mckinsey. Derived from von Prognos/EWi Studie



- Electricity will play a major role in the future heat supply.
- In 2030 68% of heating will be based on electricity producing or using technologies

… will lead to power driven systems and close the gap between the decentralized heat-market and the electricity-market


HOW DO WE SOLVE THAT?

VATTENFALL HEAT

- We are one of Europe's **largest heat suppliers** …

- We record **less than 1% p.a. customer churn** in our **>2 m end customer base** …

- We **deliver 9% ROCE** in the Heat portfolio …

BOOM TOWN ACCELERATOR

- … and we **serve Europe's growth powerhouses** (Berlin, Amsterdam, Hamburg, Uppsala, …)

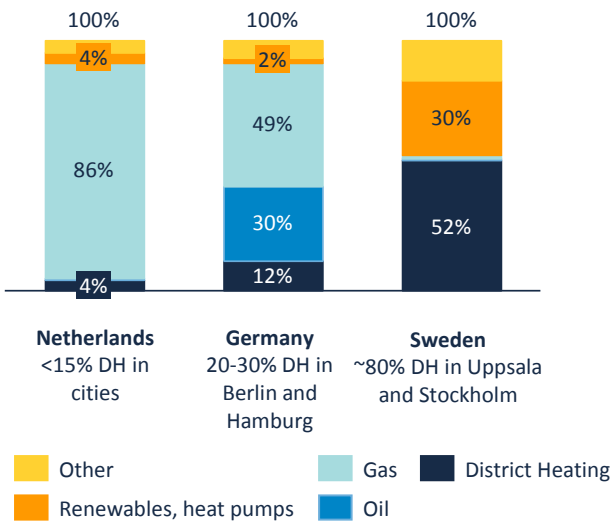
- … and we enjoy **substantial political support from our partners to grow and expand** our presence

- … and base this on a detailed roadmap towards **CO_2 neutrality** in Heat

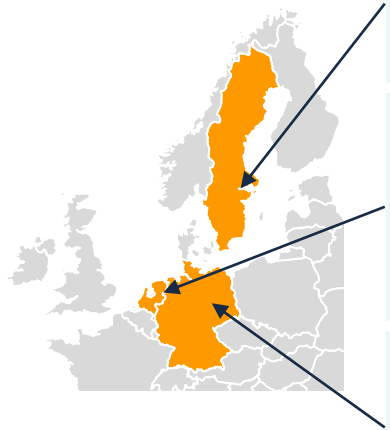
Vattenfall Heat fits well with the new energy landscape and offers further growth potential

POTENTIAL FOR PROFITABLE GROWTH

Residential heat market structure[1]



Our (current) footprint



Sweden – mature DH market
- Strong growth in metropolitan areas expected (esp. Stockholm, Uppsala)
- District heating providing CO_2-free base supply, heat pumps taking larger market share

Netherlands – young DH market
- Strong growth in Amsterdam and surroundings (+6% p.a.)
- Ambition to replace gas by 2050; an opportunity for district heating growth
- District heating with high usage of third party heat sources (waste, etc.), growth of heat pumps

Germany – developing DH market
- Hamburg and Berlin "boom" towns of the future
- District heating based on climate neutral solutions in densely populated areas; modern decentralised solutions (gas based, heat pumps) replacing old oil and gas boilers elsewhere

A well balanced market mix allows Vattenfall to capitalize on growth opportunities

[1] Source: Vattenfall analysis

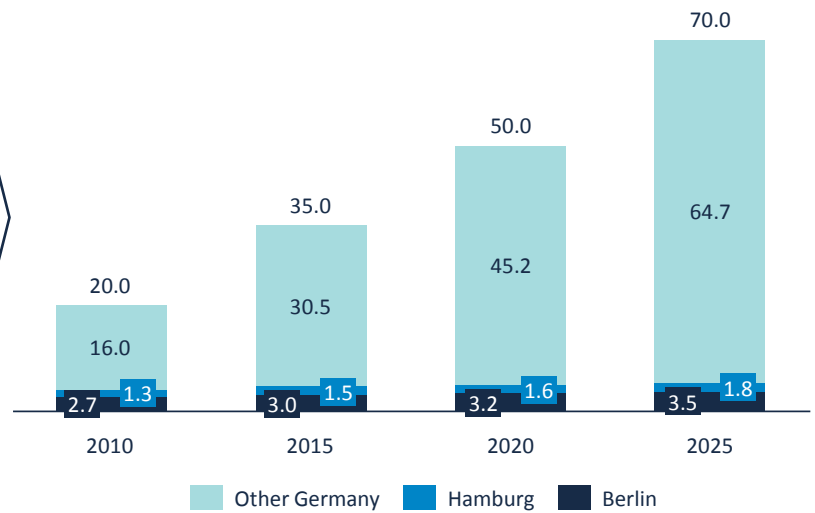
GROWTH OPPORTUNITY IN DECENTRALISED SOLUTIONS

Customer growth

Decentral growth:

- Focus on B2B-segment
- Organic growth in Berlin and Hamburg and adjacent cities and potential for inorganic growth
- Bundling of our distributed business into one entity
- Current product = heat solutions with gas boilers and mCHPs
- Future: add renewable sources to offering

Decentral heat contracting demand in Germany (TWh)[1]



Decentralised solutions are already today substantial contributors to Vattenfall Heat's performance and have a strong potential for future growth

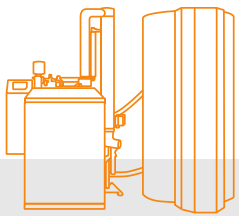
[1] Source: Prognos & Vattenfall analysis

VATTENFALL ENERGY SOLUTIONS

We bring the best fitting energy solution into your building

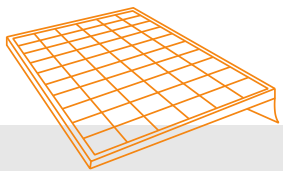
VATTENFALL

OUR SOLUTIONS



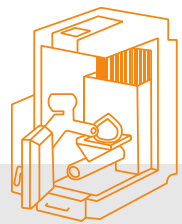
Boiler + micro CHP

- flexible, reliable and economical
- Highly efficient Heat and Power Production
- Electricity supply for tenants available
- optimized noise-reduction-emission
- fits to any building size



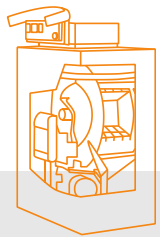
Boiler + Solar heat

- flexible, reliable and economical
- Solar heat generates 100% renewable Heat
- small space needed
- Rooftop-Space necessary
- Especially suitable for building with 10-30 units



Wood pellet boiler

- Renewable fuel
- Combinatoin with gas boiler for more flexibility
- Full automatic pellet combustion
- Pellet depot has to be installed close to the boiler
- For buildings of max. 30 units



Boiler

- Gas-powered boiler
- Admissible just for existing building

OUR PRODUCTS

Heat

Individual Heat-concepts directly at side, e.g. by a micro CHP in combination with a boiler

Power

Environmental friendly power, generated by photovoltaic or micro CHPs

Cooling

Smart cooling solutions in districts, for example through locally produced district cooling

ADVANTAGES

Perfectly Tailored Solutions
We develop an individual supply concept – from planning to installation of the plant. We find a perfectly tailored solution – matching the requirements of your building.

Financing
We finance the new plant technology up to 100%. You wish to apply for funds and authorization processes – we are happy to assist you.

Stable Energy Costs
You get a completely secured calculation: additional costs for operation, maintenance or repair do not exist.

Innovative Technologies
Be always up-to-date: our technologies and fuels are efficient, affordable and tailored for your need.

Improved Primary Energy Factor
Eco-friendly and ecological at once – we help you to find an appropriate technology to improve the primary energy factor of your building (according to EEWärmeG, EnEV).

24-Hour-Service
Our employees are available day and night. A highly qualified service personnel has a quick response time, which enables us to resolve occurring errors swiftly.

SUCCESS PROJECTS 2017

TARPENBEKER UFER, Hamburg

- Building activities started in northern Hamburg of new residential area
- 750 flats and kindergarden will be supplied with Heat by Vattenfall Energy Solutions
- 10 micro CHPs
- Total heat capacity of 3,400 kW

BRAMFELDER DORFPLATZ, Hamburg

- 2 buildings with a residential and commercial area of approx. 12,900 m² (heated area)
- Heat capacity: 700 kW
- Decentral heat supply system including local heating network and substation
- Total heat dempand per year: 510,000 kWh

BRUNO-TAUT-STRAßE, Berlin

- 9 buildings with residential and commercial area of 25,000 m²
- Total Heat demand per year: 2,800,000 kWh
- heat supply system including local heating network and 8 stations
- total heat capacity: 1,520 kW

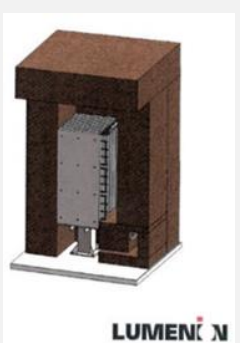
PRODUCT DEVELOPMENT PORTFOLIO

Tenant PV electricity Campaign

- PV power from the roof
- Fair electricity prices for tenants
- Professional construction and operation
- Certification of CO_2 savings per plant
- Marketing under the name of the housing association company

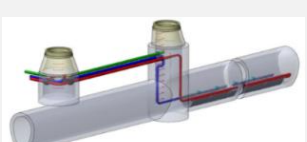
Power to Heat to Power

- Power to Heat in combination with Heat storage
- Pilot project with Lumenion
- Project planned in cooperation with Gewobag
- Storage capacity approx. 8 MWh $_{th.}$ at 600 °C.



Sewage Heat Utilization Grüne Aue

- sewage water supplied heat pump for permanent high COP
- CHP provides electric energy for the heat pump to avoid using electricity from public grid
- Heat from Heatpump, CHP and condensing boiler is used to feed a low temperature district heat net for 77 single-family houses and 3 multi-family houses



“At Vattenfall, we exist to power climate smarter living”

VATTENFALL