ÅF on CHP in Finland

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- CHP’s role today and near future
- Future electricity prices and LCOEs?
- Making biomass CHP investment today
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Facts at a glance

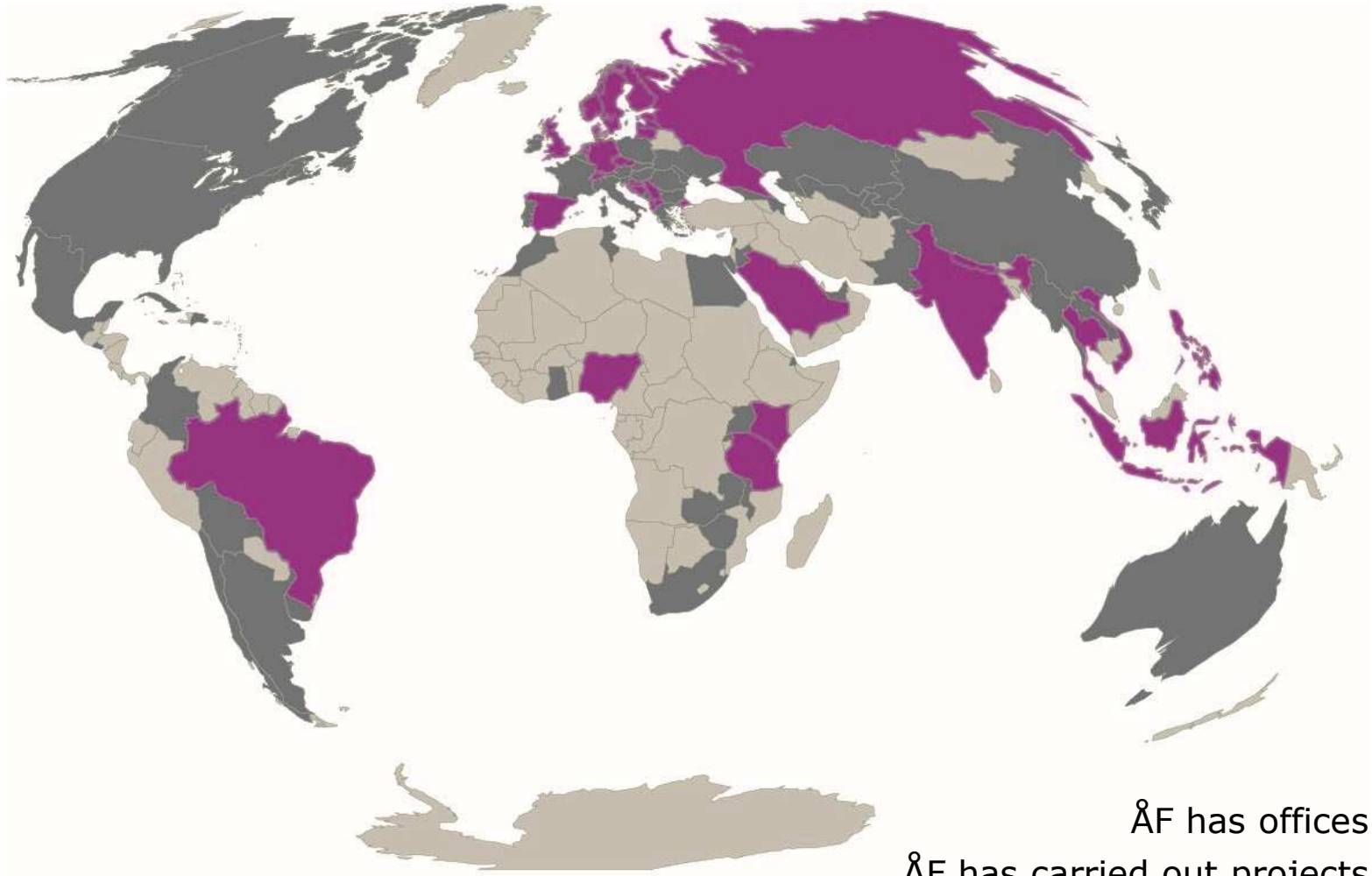
- **Sales** ~10,000 SEK million
- **Number of employees:** 9,500
- **Number of ÅF offices:** 100
- **Geographical coverage:** Established in more than 30 countries, assignments are carried out in over 100 countries

Development 2005-2015

Net sales (MSEK)	2.405 to 9.851
EBIT* (MSEK) *excl. item affecting comparability	90 to 832
EBIT %	4,0% to 8,4%
The ÅF share	+816%

ÅF has assignments worldwide

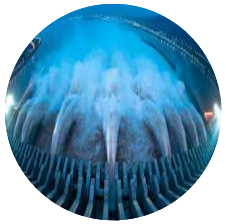
ÅF is currently active in around 90 countries



Energy





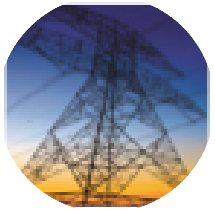


Hydro Power Development

Thermal Plants Development

Nuclear Plants

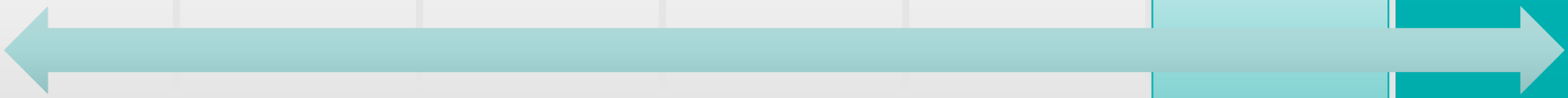
Renewable Plants Development



Transmission & Distribution Projects

Smart Grids & Utilities Solutions

Policy, Regulations and Sustainability



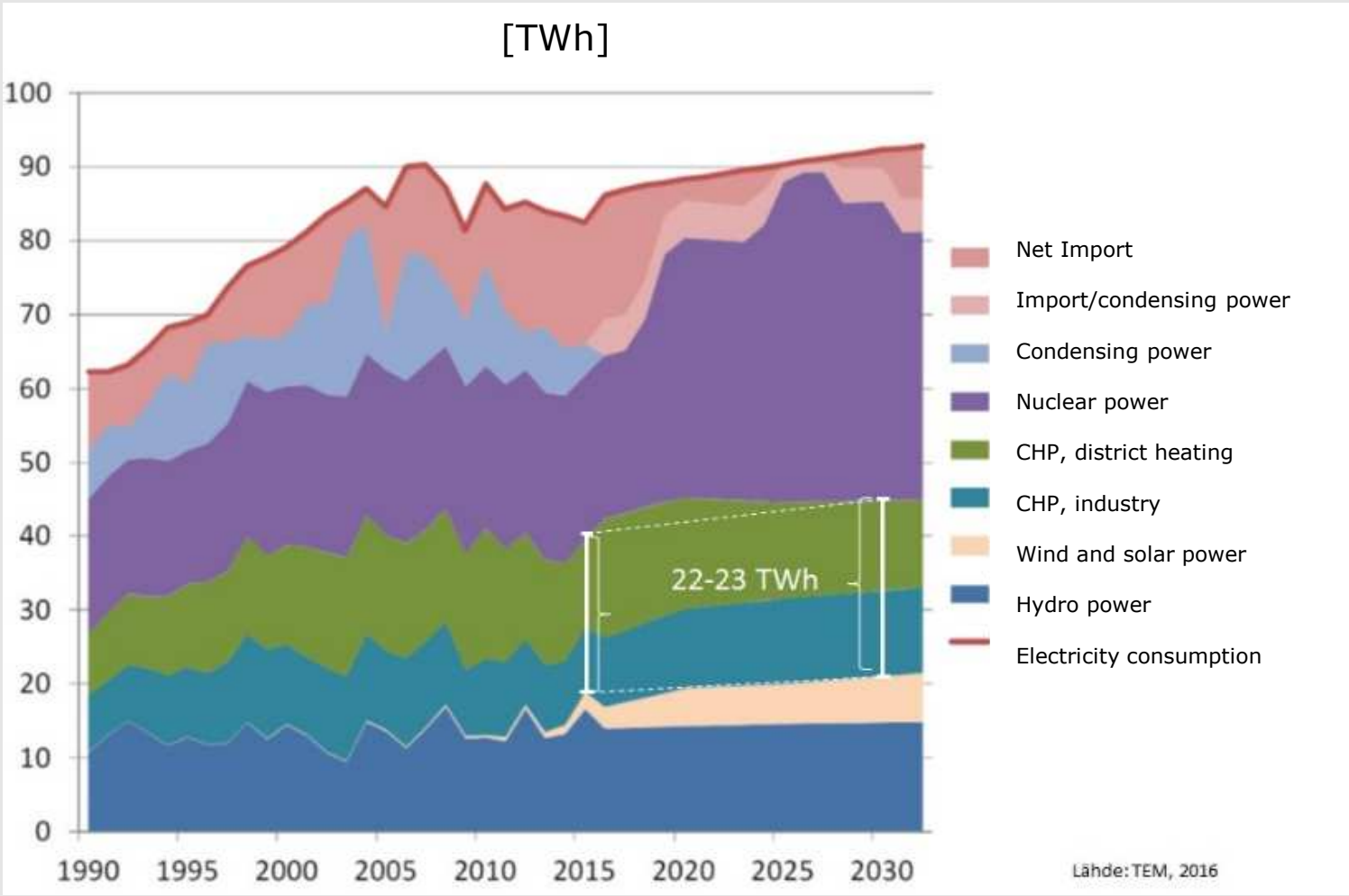
Our Clients

- Power utilities
- Energy related industry
- Government/municipalities
- Local authorities
- Transmission/Distribution companies
- Intern. funding institutions
- Construction companies
- Industrial companies

CHP’s role today and near future

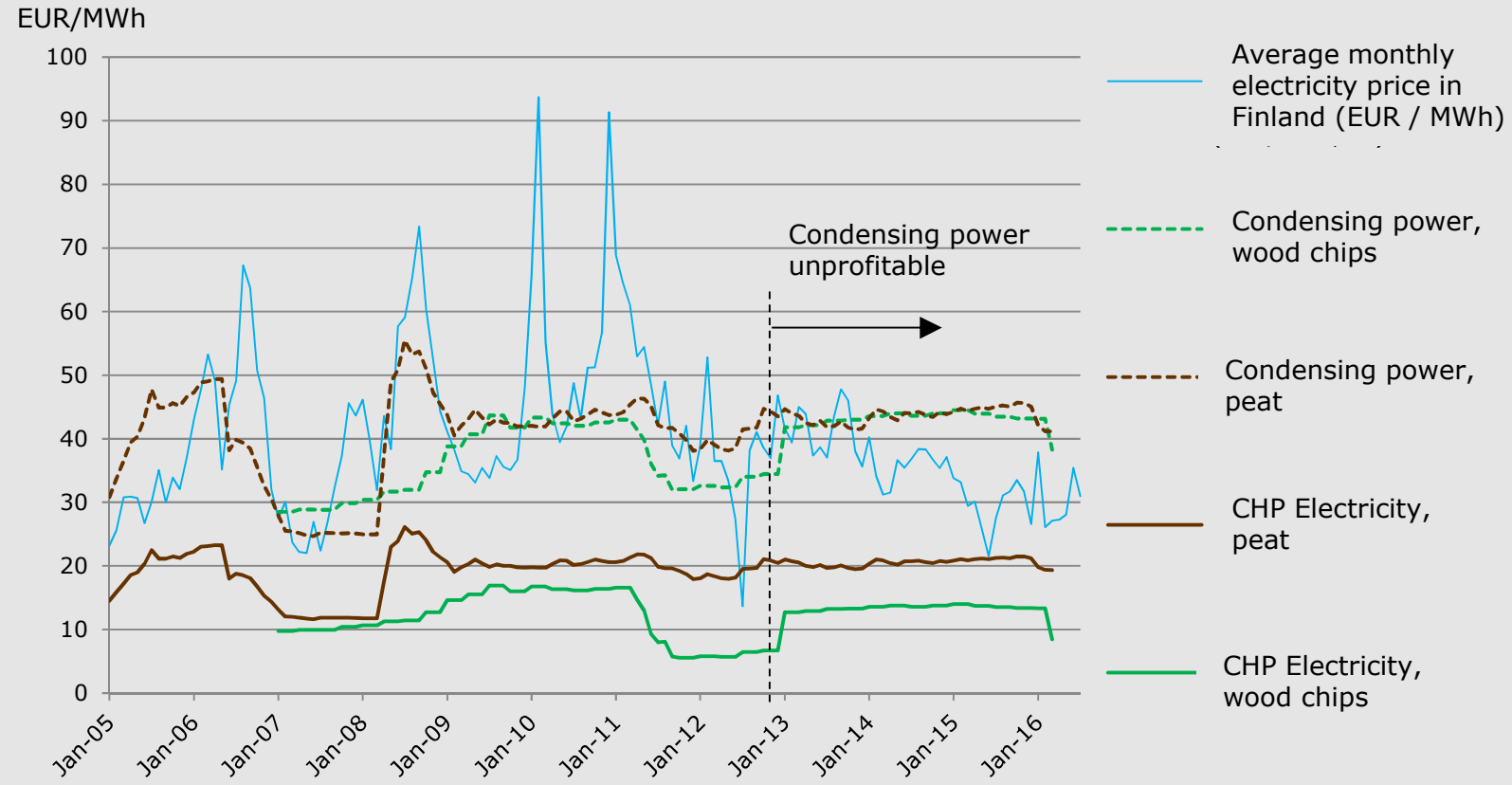
Energy and climate strategy 2016

Ministry baseline scenario suggests that CHP based electricity generation will remain roughly at the level of 2015 until 2030.



Low electricity prices

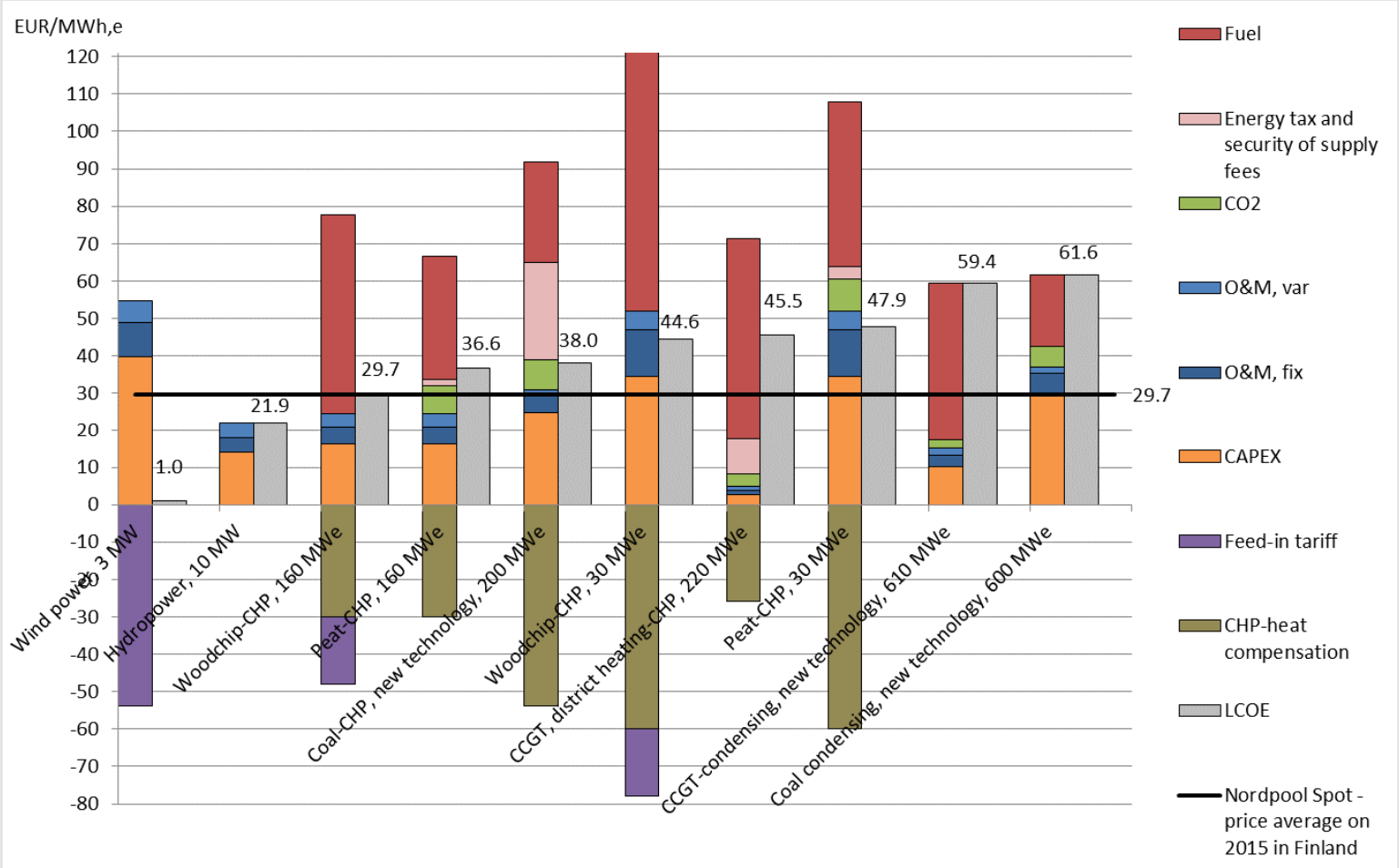
Existing wood chip and peat fired CHP el. generation still mainly profitable but condensing power after 2013 not.



Data: Tilastokeskus, ÅF

LCOE vrs. Current electricity prices

CHP's levelized cost of electricity does not encourage to new turbine investments

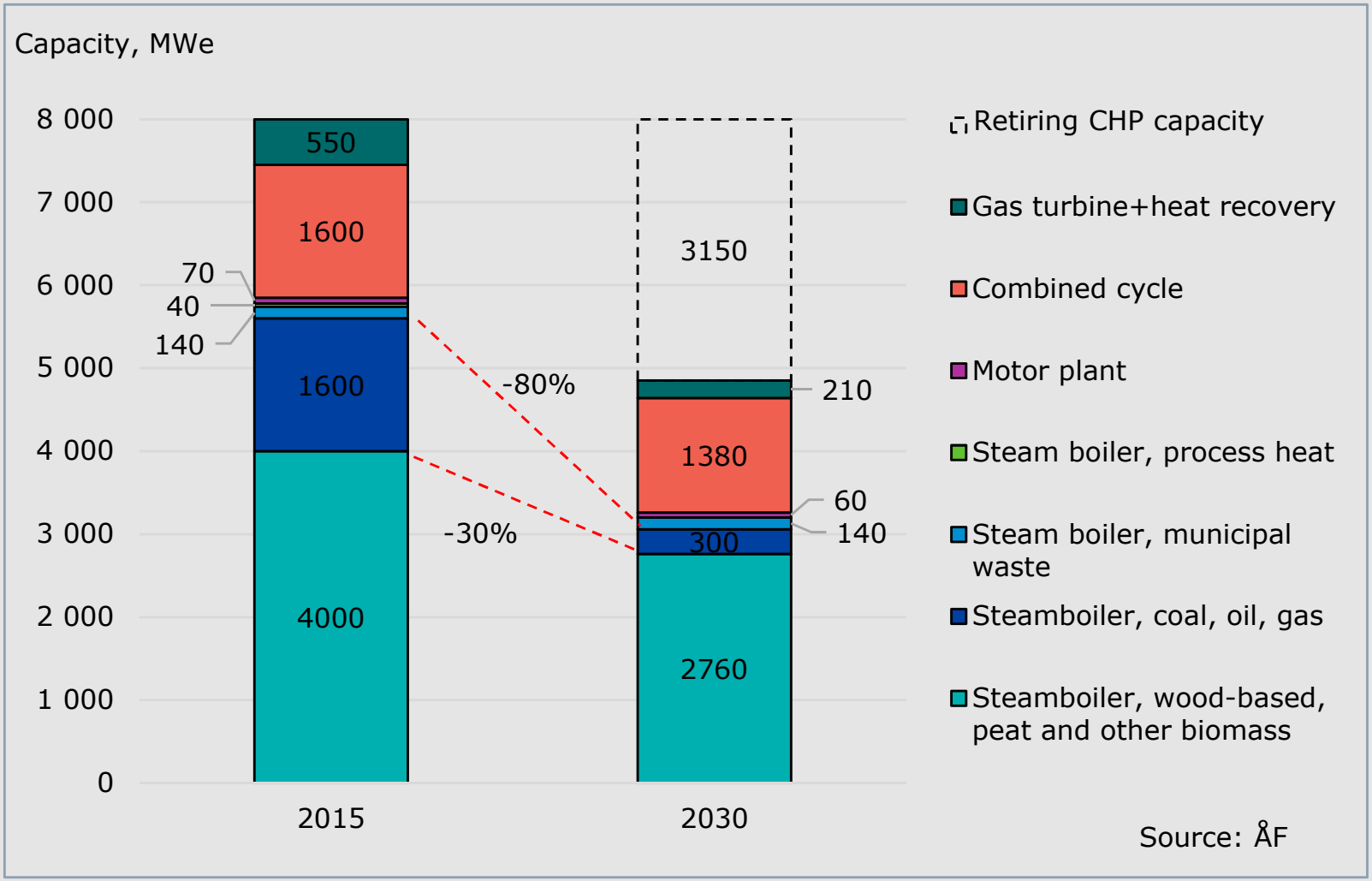


CHP-heat compensation on heat price 30 EUR/MWh (Alternative cost for HOB). Taxes and tariffs taken on 1.3.2016, average prices on 2015. WACC 4,9 %.
CCGT = combined cycle gas turbine

Data: ÅF, Nord Pool Spot, Tilastokeskus

Retiring CHP capacity in Finland

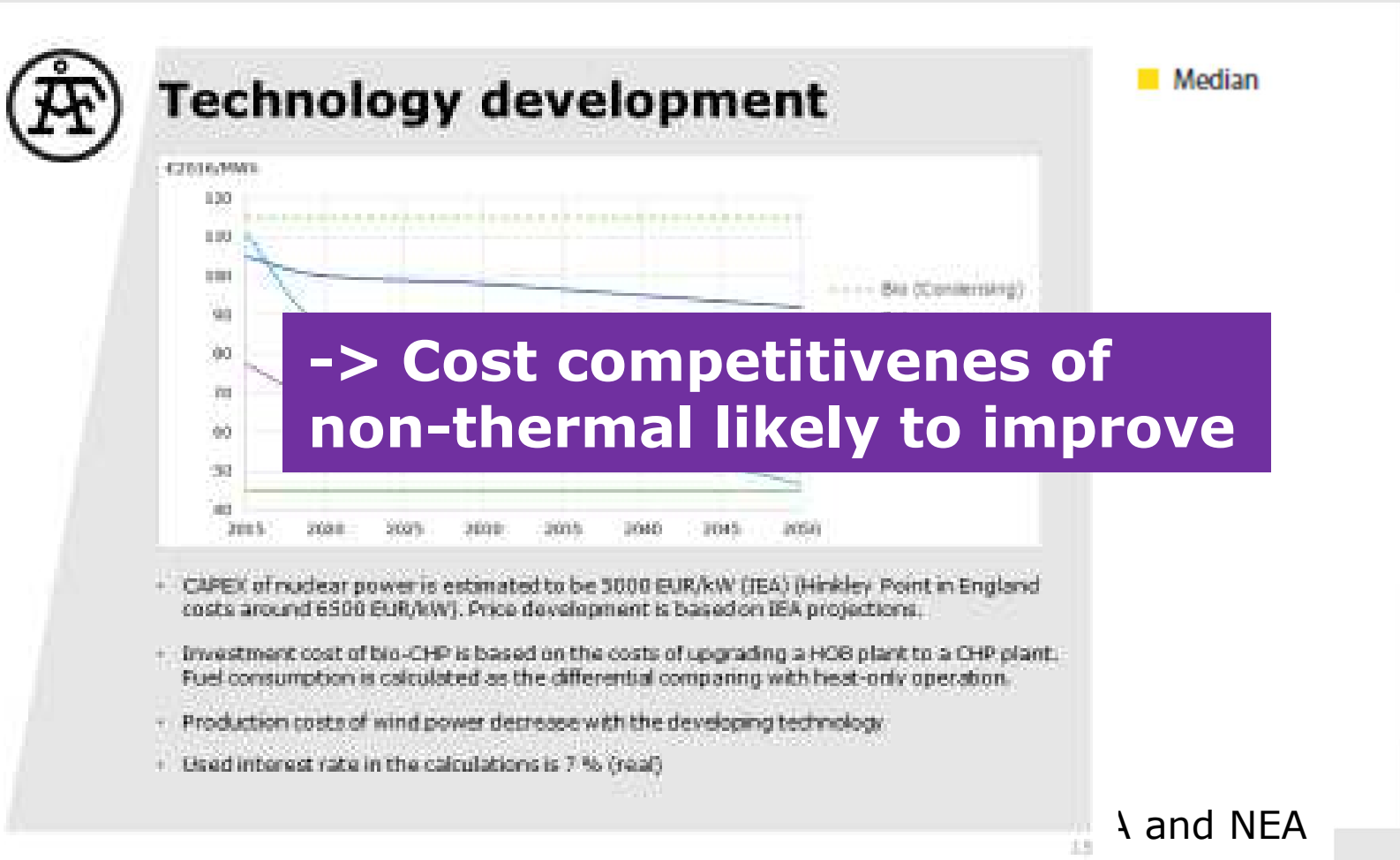
Decomissioning CHP electricity generation capacity by 2030



Future electricity prices and LCOEs?

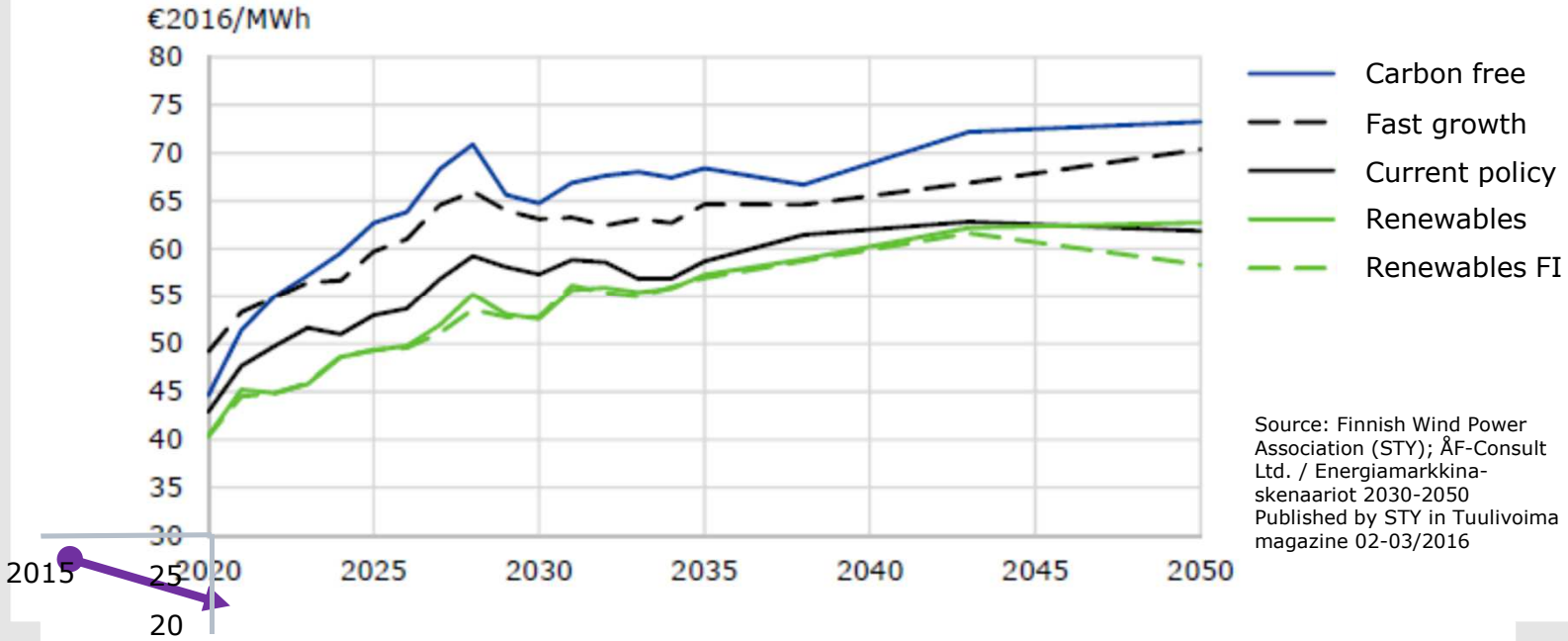
Technology development

LCOE of REN technologies is expected to continue to come down



Electricity prices

Electricity prices expected to remain low, but how low and for how long?



Source: Finnish Wind Power Association (STY); ÅF-Consult Ltd. / Energiamarkkina-skenaariot 2030-2050 Published by STY in Tuulivoima magazine 02-03/2016

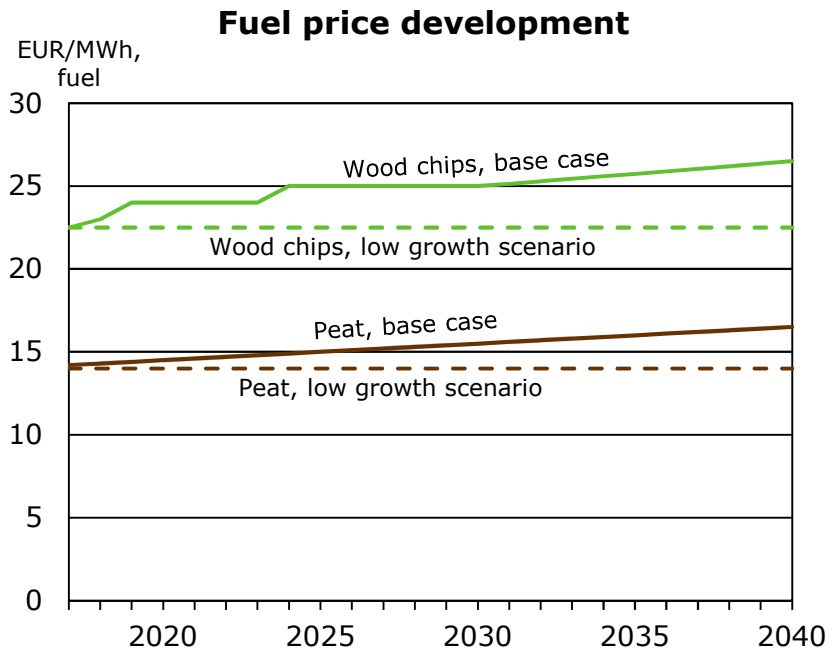
2016: Nordpool systen price day ahead average was 26,9 EUR/MWh

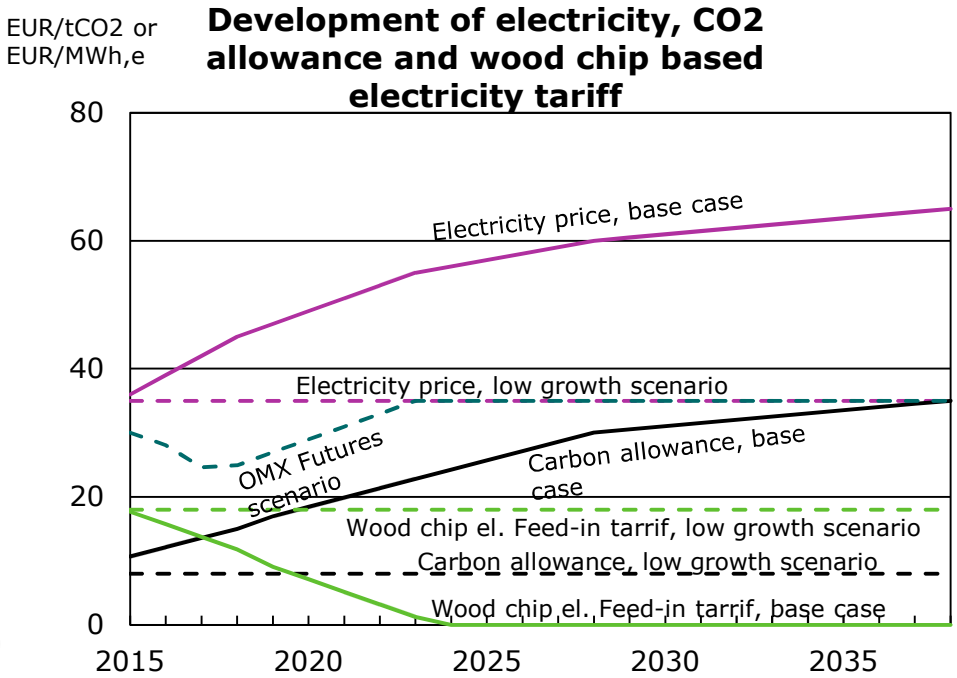
2021: March 24th 2017 OMX Futures last transaction for 2021 was 23 EUR/MWh

Making biomass CHP investment today

Assumptions for future development

Fuel and electricity prices based on TEM 2016 scenarios and futures prices OMX Nasdag prices





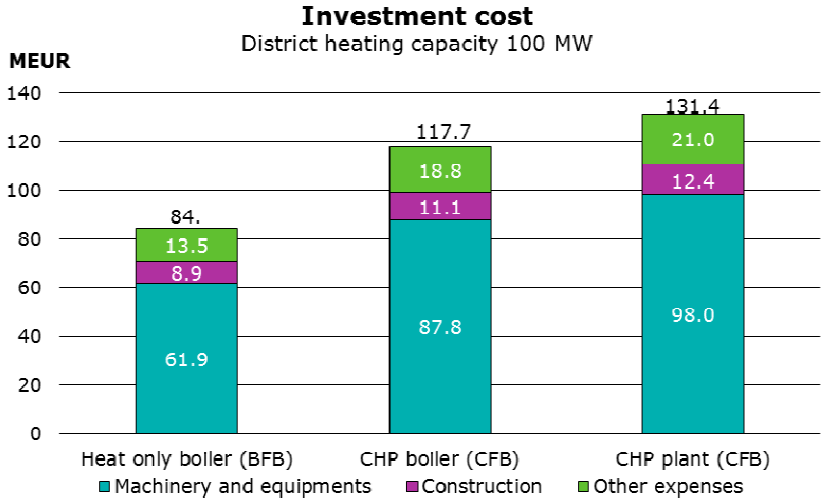
Fuel Prices:
2015 - 2030: TEM, Energy and climate strategy
2030 - 2040: ÅF

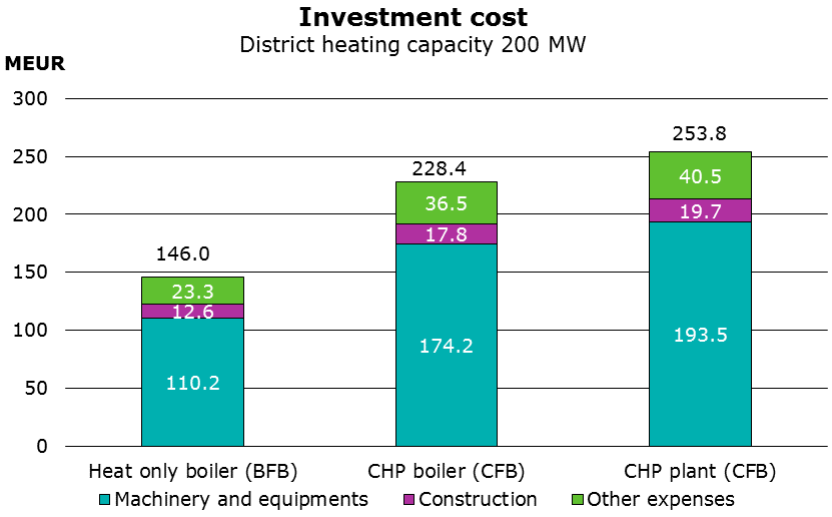
Investment options

Selected CHP investment options are based on district heating capacity of 100MW and 200MW

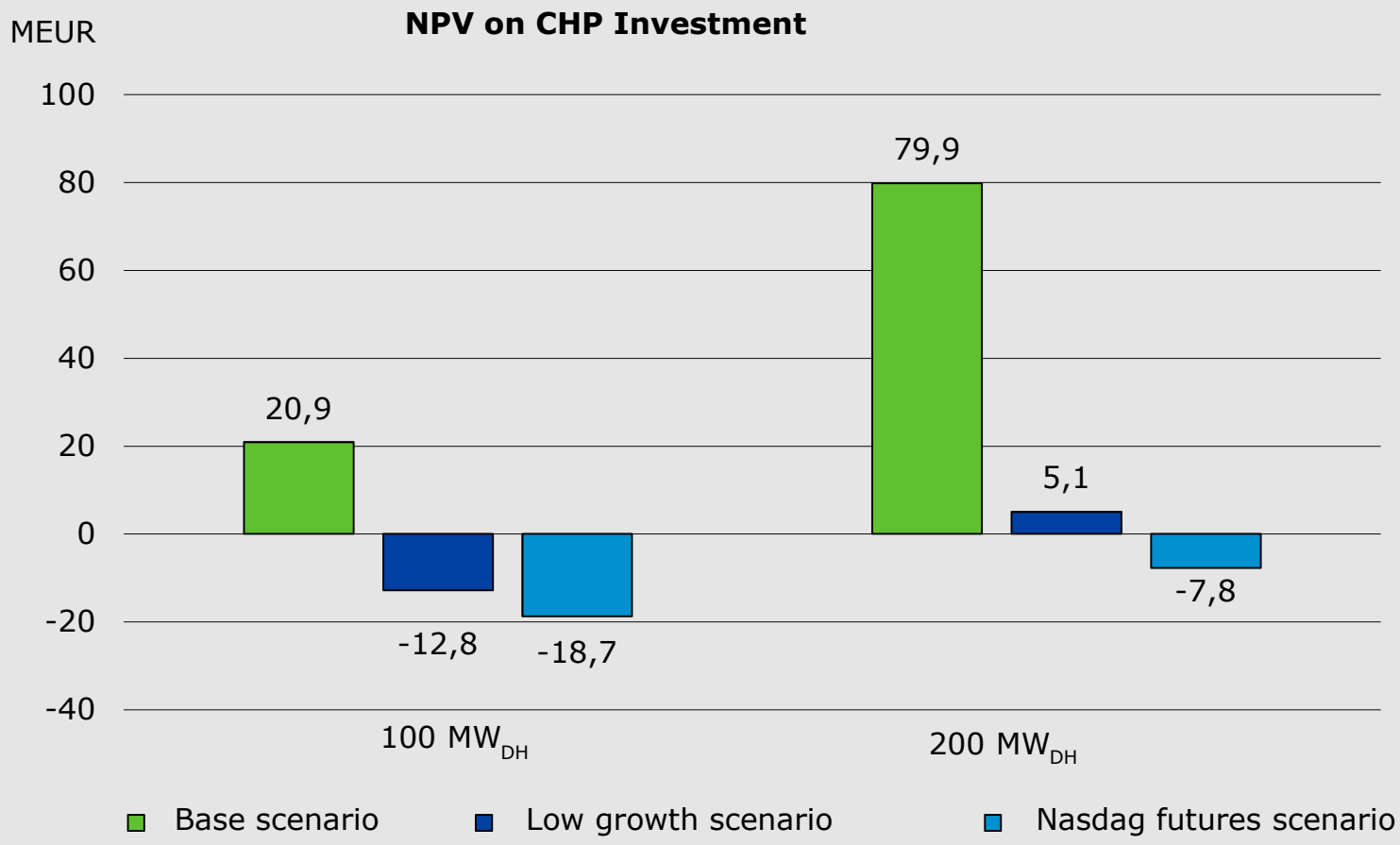
Values	100 MW_{DH}	200 MW_{DH}
Power net, MW	32	80
Livesteam, bar / °C	90 / 510	105 / 540
WACC (real)	4,5%	4,5%
Equity/Loan	30/70	30/70
Payback time	25y	25y

- District heating and power generation capacity selected as per typical commercial solution today
- Reference HOB: BFB-boiler including equipment and buildings. Base for the alternative heat supply -> Cost of DH [EUR/MWh]
- Steam boiler: CFB-boiler including equipment and buildings, including turbine option (typical approach today
- Heat recovery system included in all options
- Current TEM feed-in for wood chip based electricity included and taxes as per today





Investments on CHP-capacity



Conclusions

- Energy and climate strategy assumes that CHP will have current role in Finnish electricity generation capacity also in 2030
- CHP capacity of over 3000MWe retiring from the system by 2030, of which 1200MWe wood based
- Due to low electricity prices retiring CHP is being replaced with heat only boilers, mainly bio based HOBs for DH purposes
- Wind and solar will become more price competitive due to foreseen technology, business model development and availability of low cost finance
- TEM base scenario seems to be sufficient for CHP replacement investments. However, market seems to develop another direction than base scenario.
- Today biomass based CHP investments are hard or impossible to justify for DH purposes.

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