EnergyWeek 2018

Energia-alan tulevaisuuden näkymät

Heli Antila, CTO

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The global megatrends affecting our industry
Climate change and resource efficiency
Active customers
Urbanisation
Digitalisation, new technologies
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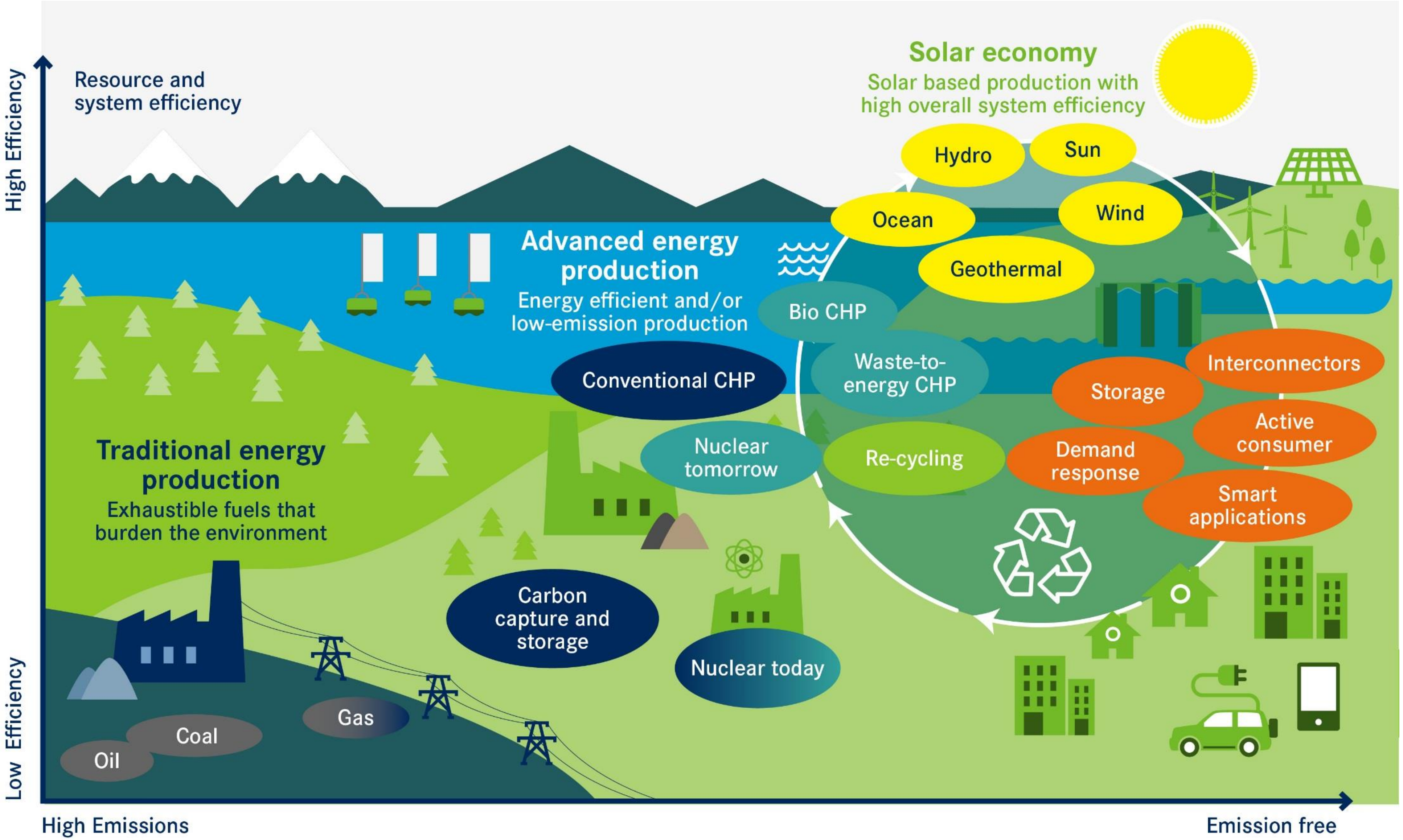
Transition towards Solar Economy is ongoing



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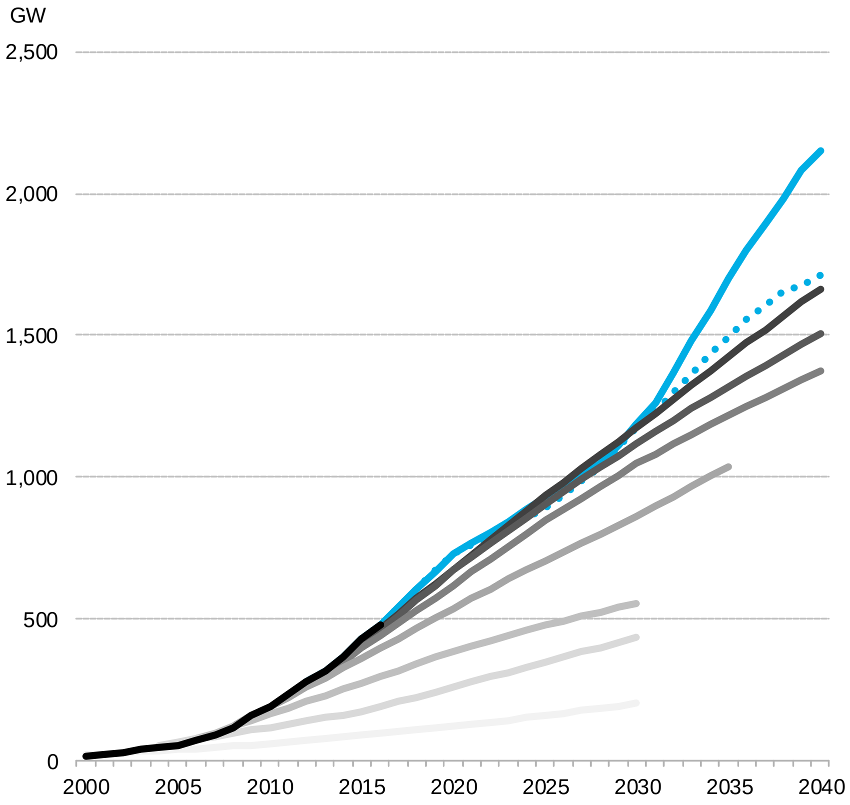
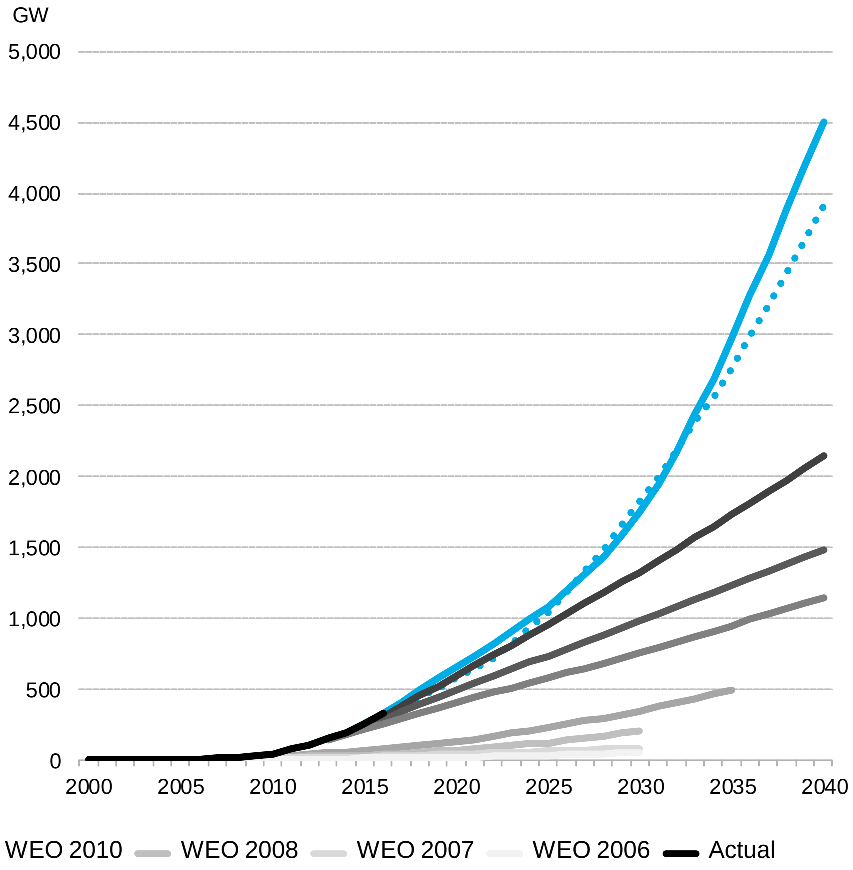
Wind and solar driving the change – scenarios lacking actual growth year by year

Cumulative installed wind capacity



Cumulative installed solar capacity

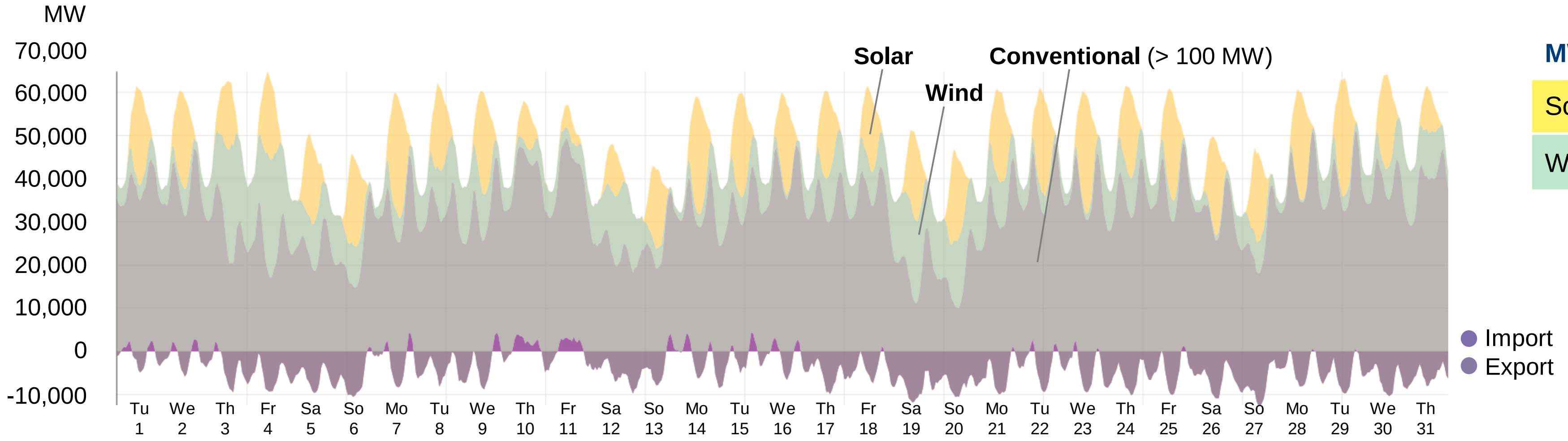


Source: Bloomberg New Energy Finance, IEA; Note: WEO 2002, 2006 & 2008 is Reference scenario; WEO 2010 - 2017 is **New Policies scenario;** wind includes onshore and offshore wind and solar includes utility-scale, small-scale PV and solar thermal

Electricity generation and electricity price in Germany

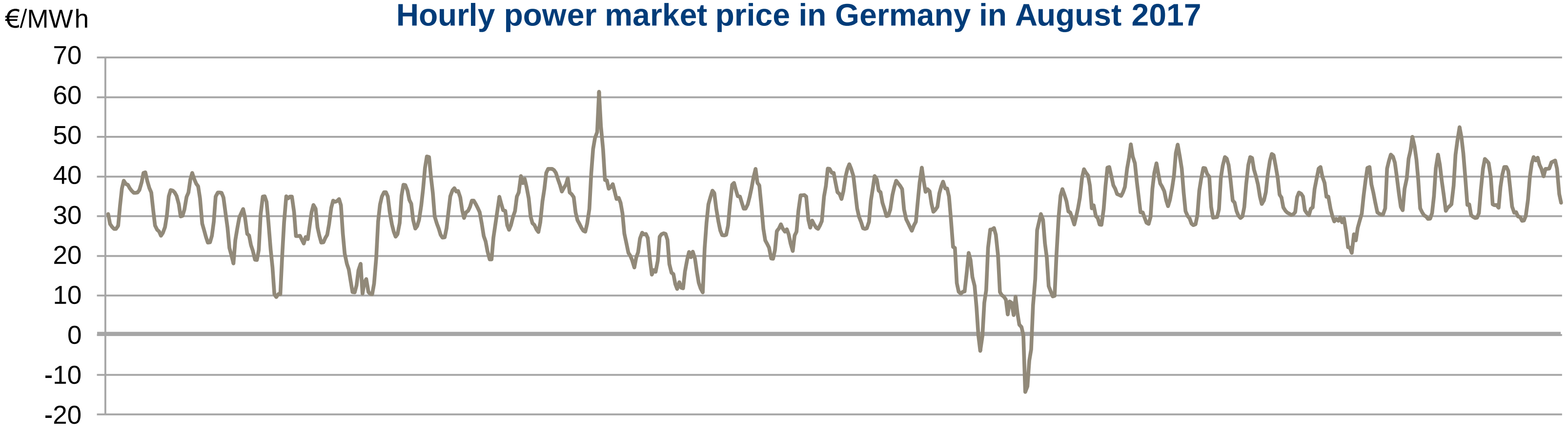
August 2017

Hourly electricity generation in Germany in August 2017



MW	Installed capacity 31 Dec '16	Average generation August '17
Solar	39,800	6,720
Wind	49,100	7,490

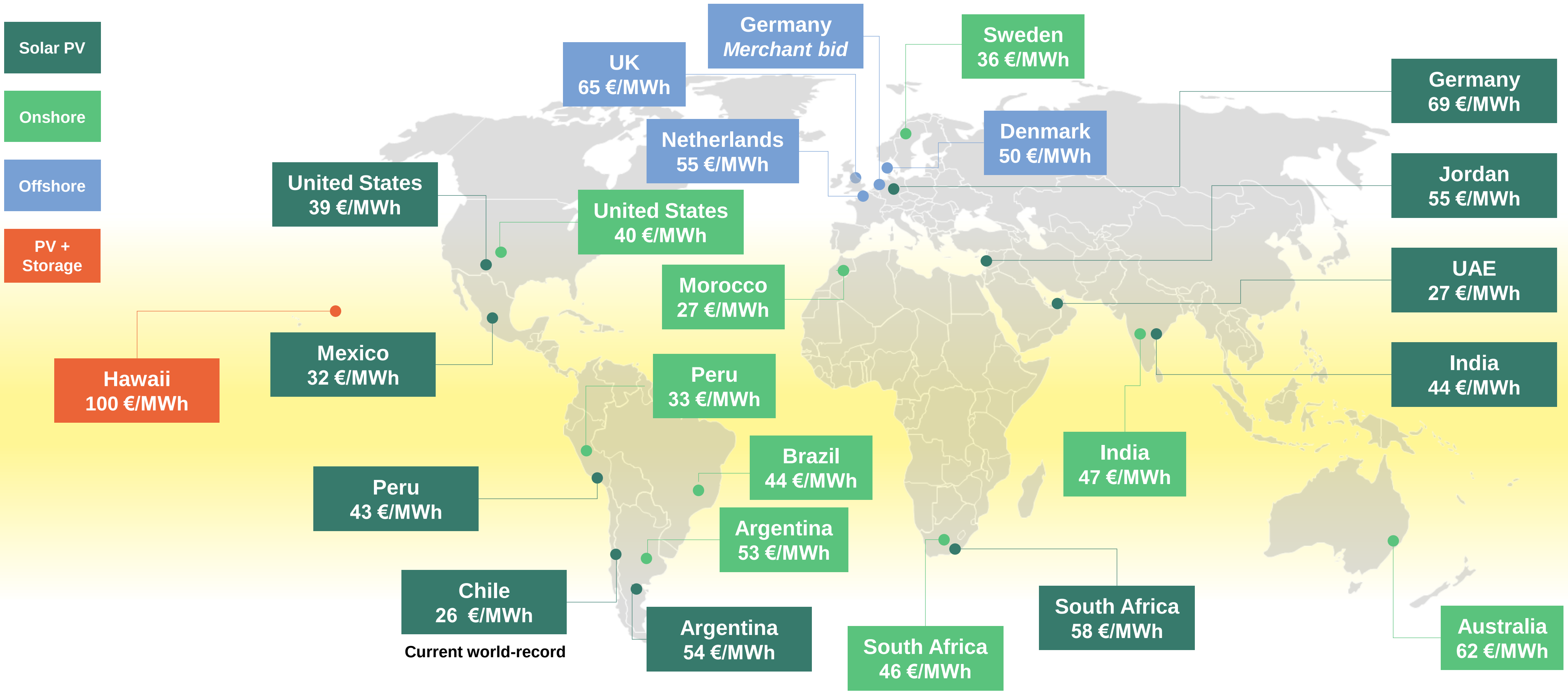
Hourly power market price in Germany in August 2017



Source: Electricity generation graph: Bruno Burger, Fraunhofer ISE, price curve: Thomson Reuters, wind and solar installed capacity: ENTSO-E

Solar more competitive in sunbelt, wind in North – in retail, solar compelling everywhere, also in the Nordics

Lowest recently announced long-term PPA contract prices and auction results, without subsidies[1]



[1] Announcements by the investing companies and IEA report "Renewable Energy Medium-Term Market Report 2015" for US, Brazil, South Africa, Australia and Jordan. All values are reported in nominal euros. United States values calculated excluding tax credits. Typical contract lengths are 15-25 years. The prices indicate levels with which investors have been willing to invest, however, they may not describe the actual comparable costs as the bid prices may be reduced by preferential land prices, site exploration cost, targeted low-cost loans etc.
For Sweden the price level at which investors can hedge their renewable production for the next 4 years: average of 2017-2020 electricity (LUL) + elcertificate futures with 29.8.2016 closing prices. Newest Abu Dhabi bids were 21,6 €/MWh but the producers get 1.6 times the payment during June-September and thus the actual average is 27 €/MWh. German offshore tender zero subsidy bids are fully merchant but exclude grid and development costs.

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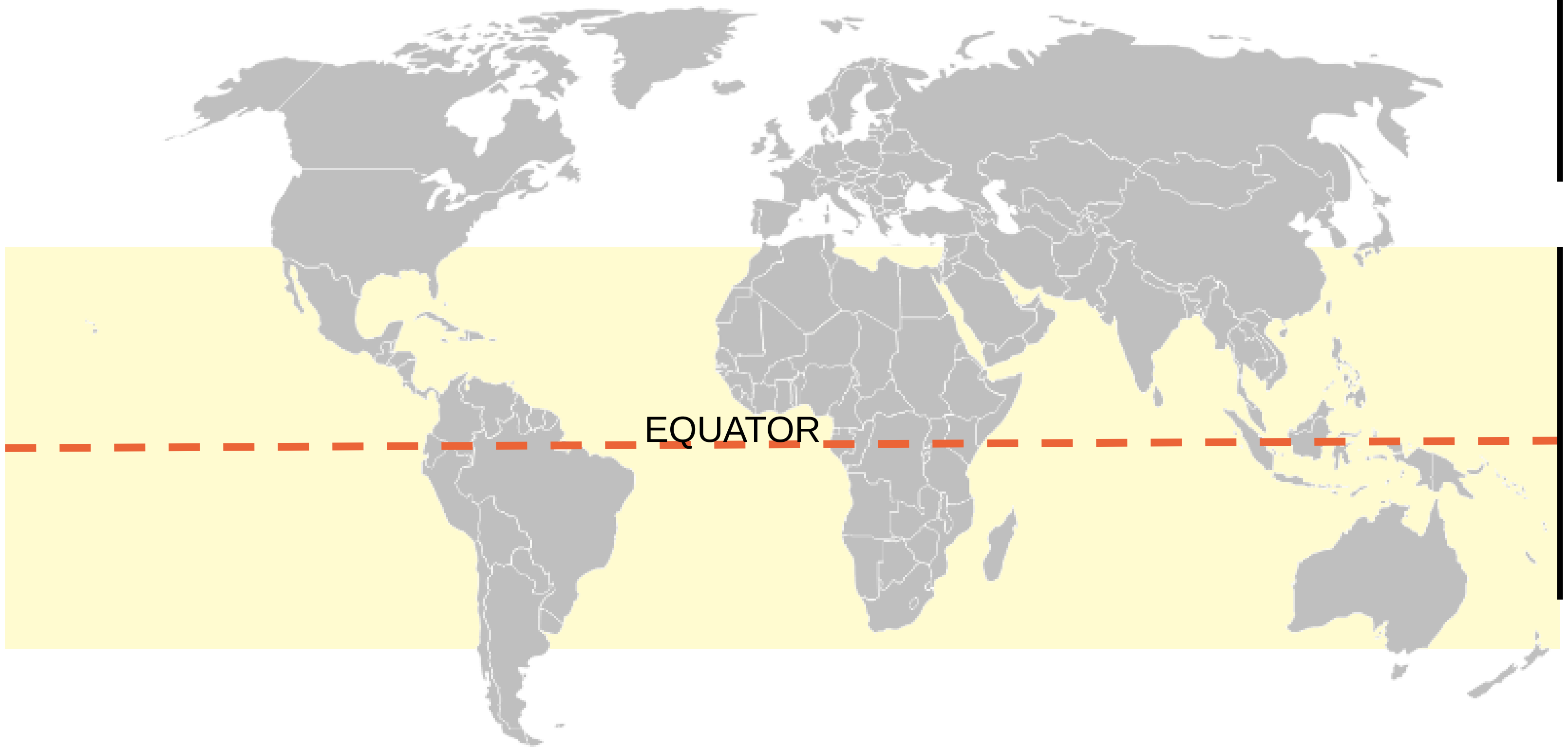
Future energy system features:

● **Security of Supply** a limited resource ● **Energy** a non limited resource



- Clear Seasonality
- Wind most competitive
- Intermittent power

- Low seasonality
- PV most competitive
- Intermittent power

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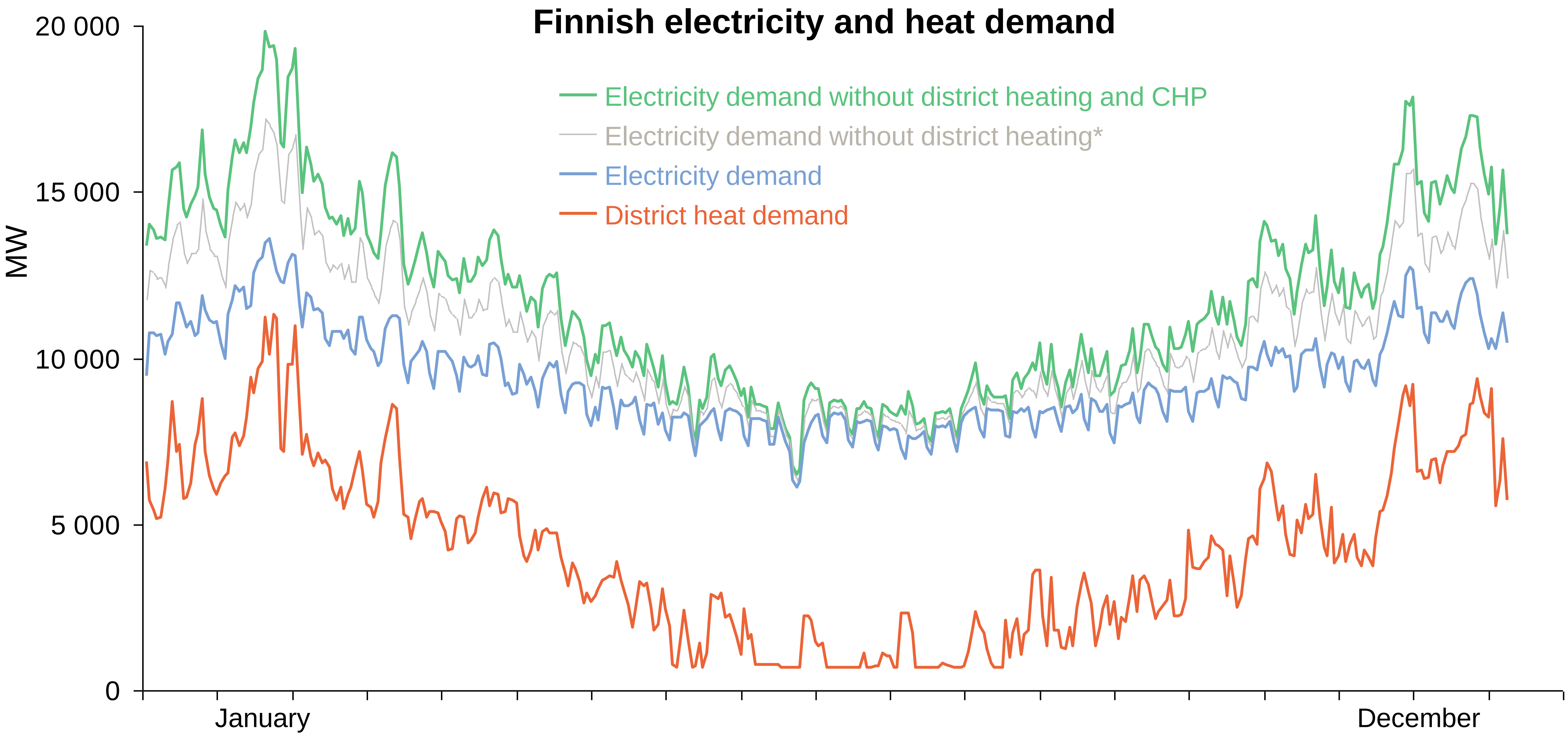
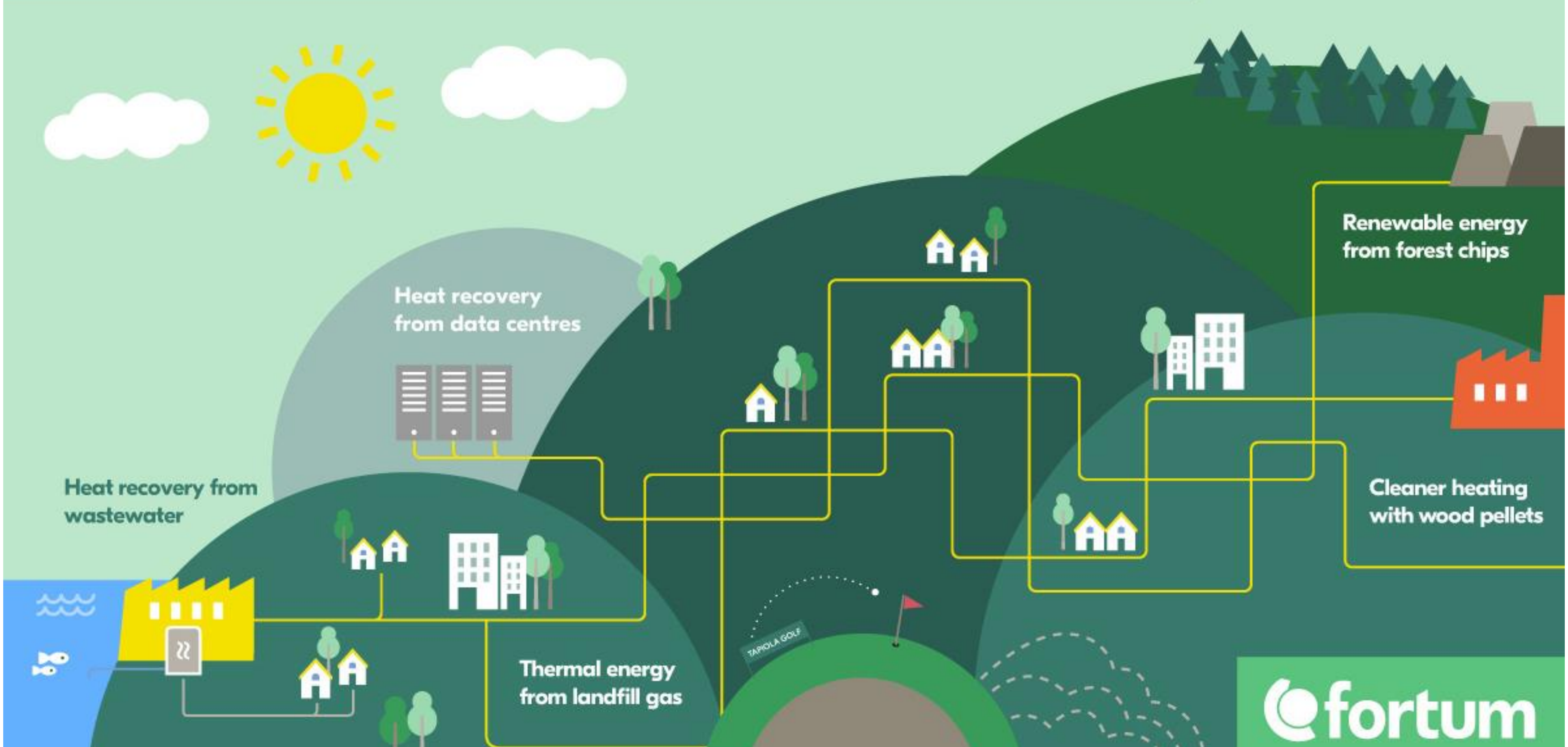
Centralised heating enables more intermittent wind and solar

If district heating and CHP were replaced by heat pumps, Finnish winter electricity demand would be ~3,700 MW higher*



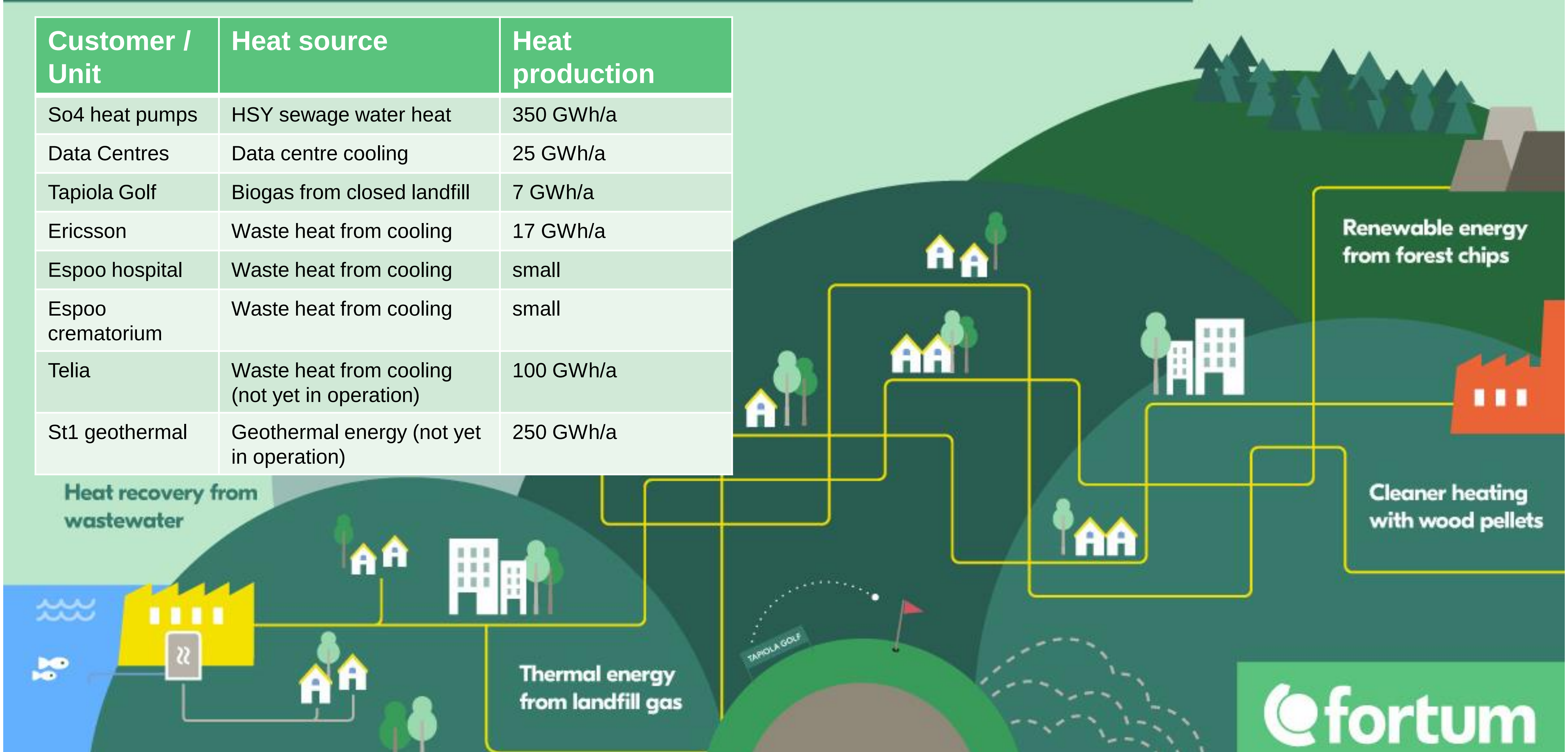
* Heat demand produced with heat pump increase electricity demand with 1/3 of the heat demand. Winter season in example January – March and November - December

District heating: cleaner heat production and lower CO_2 emissions



District heating: cleaner heat production and lower CO_2 emissions

Customer / Unit	Heat source	Heat production
So4 heat pumps	HSY sewage water heat	350 GWh/a
Data Centres	Data centre cooling	25 GWh/a
Tapiola Golf	Biogas from closed landfill	7 GWh/a
Ericsson	Waste heat from cooling	17 GWh/a
Espoo hospital	Waste heat from cooling	small
Espoo crematorium	Waste heat from cooling	small
Telia	Waste heat from cooling (not yet in operation)	100 GWh/a
St1 geothermal	Geothermal energy (not yet in operation)	250 GWh/a



Digital solutions offer new opportunities to increase living comfort and energy efficiency

SmartLiving

Control of heating by SmartHeat

- Real temperatures, weather forecasts and district heating production are taken into account
- ➢ Steady indoor temperatures
- ➢ No wasted energy
- ➢ Reduced carbon footprint

Improved living comfort

Lower energy use and costs

Demand response

Possibility to sell heat to the network

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spring by Fortum

building a virtual battery together with customers

Join the change

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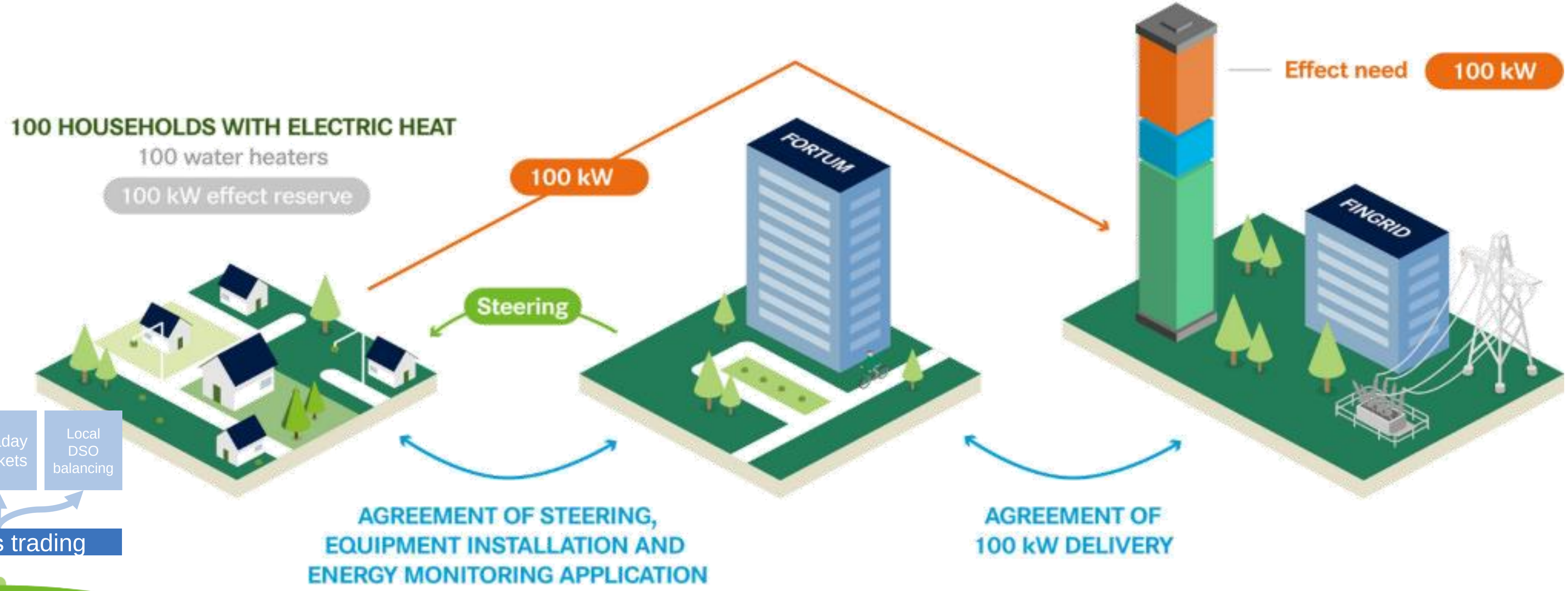
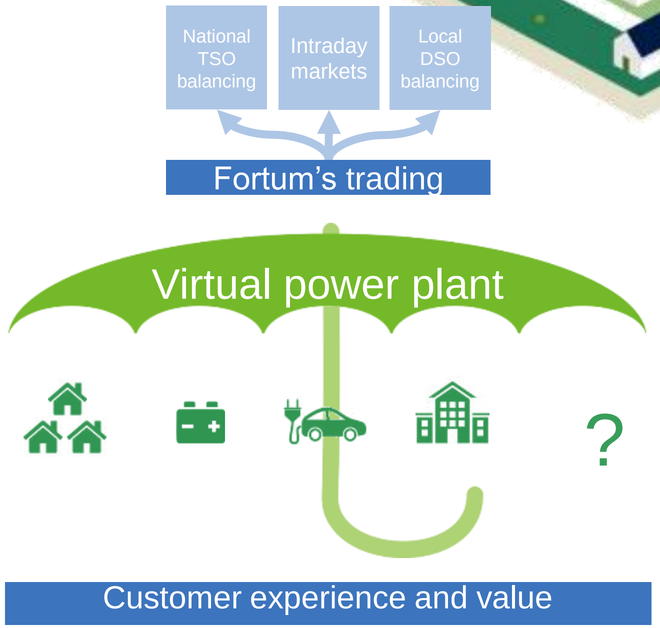
Virtual Battery Supporting Energy System, 15.1.2018 FCR-N bid to Fingrid was 1,5 MW





spring

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Spring is now delivering to customers

1500 homes

Ericsson data center

New Swedish pilot

Pilot: 1st homes in real time market in Europe (in Finland)

Pilot: 1st homes in Swedish real time market

Home and Data Center offerings launched in Finland

2016

2017

2018

Software development

Pilot development

Hardware development

Sales ramp-up

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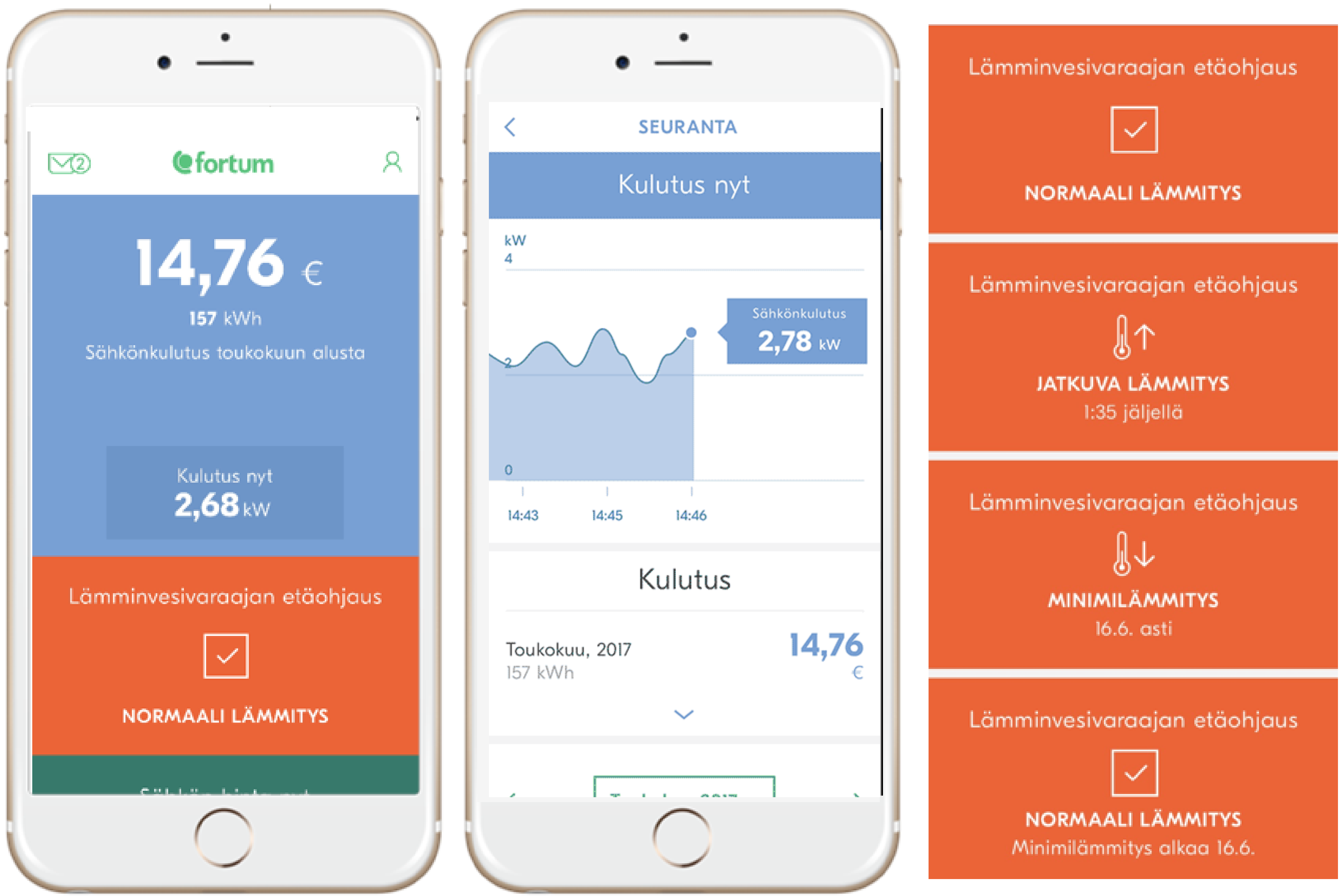

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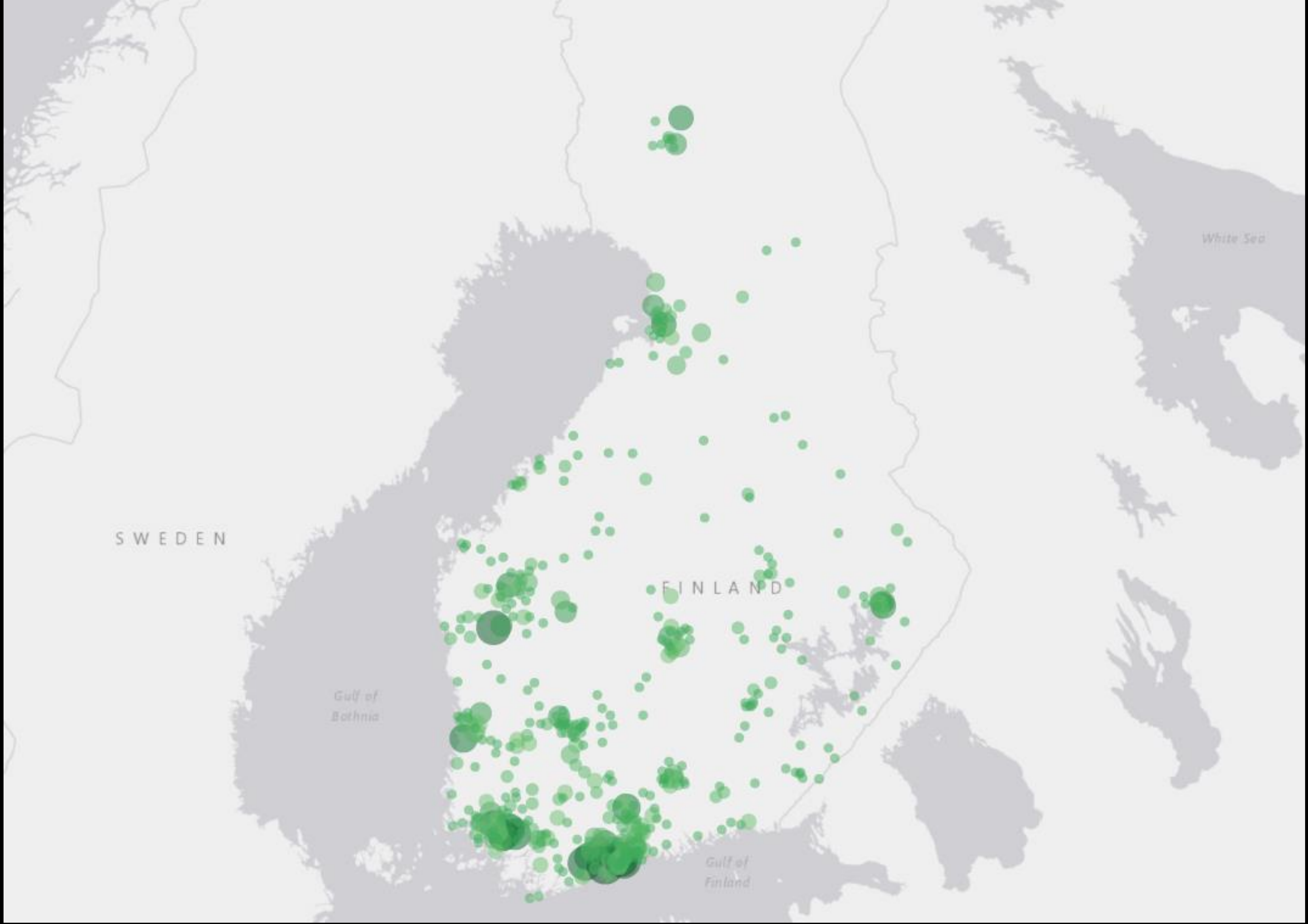
14,76 €
157 kWh
Sähkönkulutus toukokuun alusta
Kulutus nyt
2,68 kW
Lämminvesivaraajan etäohjaus
NORMAALI LÄMMITYS
SEURANTA
Kulutus nyt
kW
4
2
0
Sähkönkulutus
2,78 kW
14:43
14:45
14:46
Kulutus
Toukokuu, 2017
157 kWh
14,76
€
Lämminvesivaraajan etäohjaus
NORMAALI LÄMMITYS
Lämminvesivaraajan etäohjaus
JATKUVA LÄMMITYS
1:35 jäljellä
Lämminvesivaraajan etäohjaus
MINIMILÄMMITYS
16.6. asti
Lämminvesivaraajan etäohjaus
NORMAALI LÄMMITYS
Minimilämmitys alkaa 16.6.


White Sea
SWEDEN
FINLAND
Gulf of Bothnia
Gulf of Finland

Fortum Batcave-project

1MWh/2MW lithium-ion battery in Fortum Järvenpää CHP plant.

- Installation: Dec 2016
- Commissioning: Jan 2017
- In operation since: Feb 2017

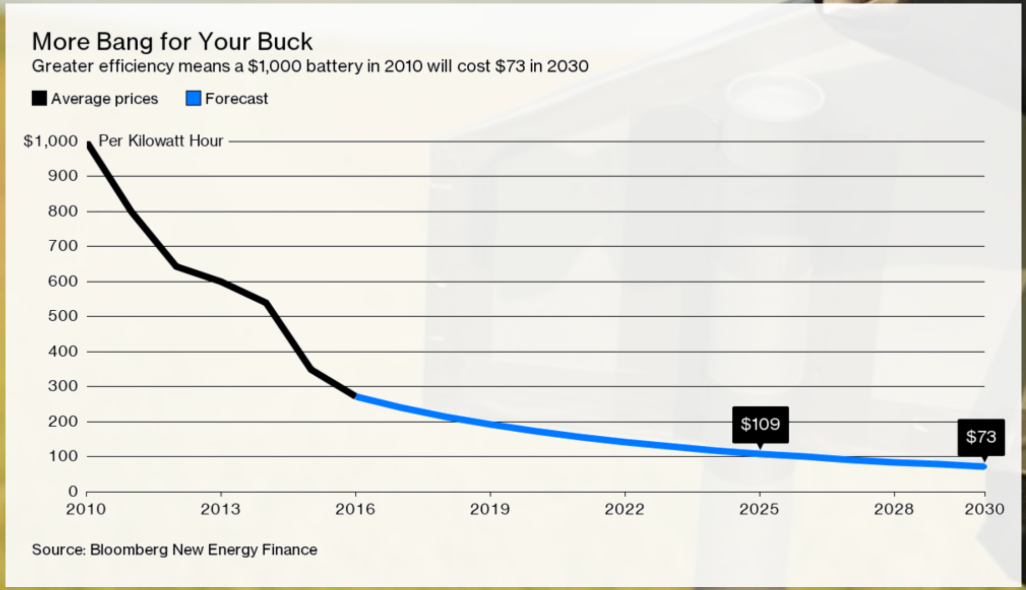
Main purpose of the battery:

- Frequency reserve to TSO (Fingrid)
- Enables Fortum to use hydro power in other purposes than frequency regulation

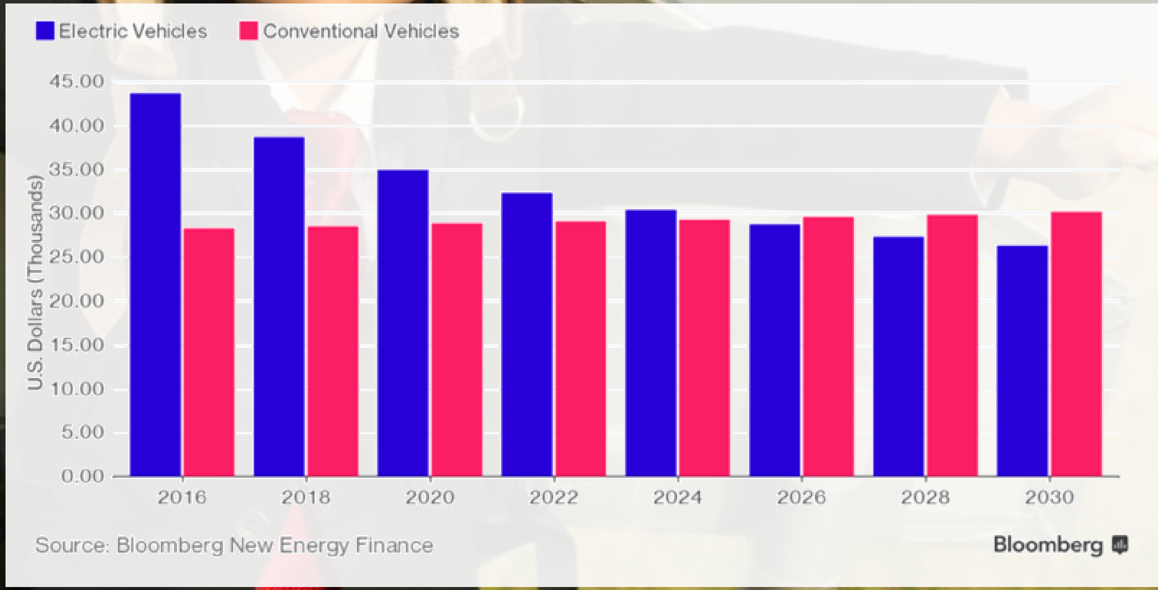
Fortum Charge & Drive

When will tomorrow come?

Battery forecast:



Price forecast (EV vs ICE):



Renault: Total ownership costs of EVs will equal conventional internal combustion engine vehicles (ICE) by the early 2020s

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Charge & Drive offers the most advanced EV charging business solution on the market.

CLOUD SERVICE

Business software for operating any smart charging network

TURN-KEY SOLUTION IN NORDIC HOME MARKETS

Comprehensive charging solutions for B2B & B2C

Fast facts

- Charge & Drive offers **simple & secure** EV charging solutions.
- Connected chargers in **16 countries**
- **1900 connected chargers** of which **36%** are fast chargers
- **Market leader in Finland and Norway**, the frontrunner in the global EV market
- Turn-key installations, **proven charging business model**, Nordic public charging network
- **60 000+** paid transactions per month
- Average **4 000** tagged & analyzed customer service calls per month
- Operations in **India** from 2017

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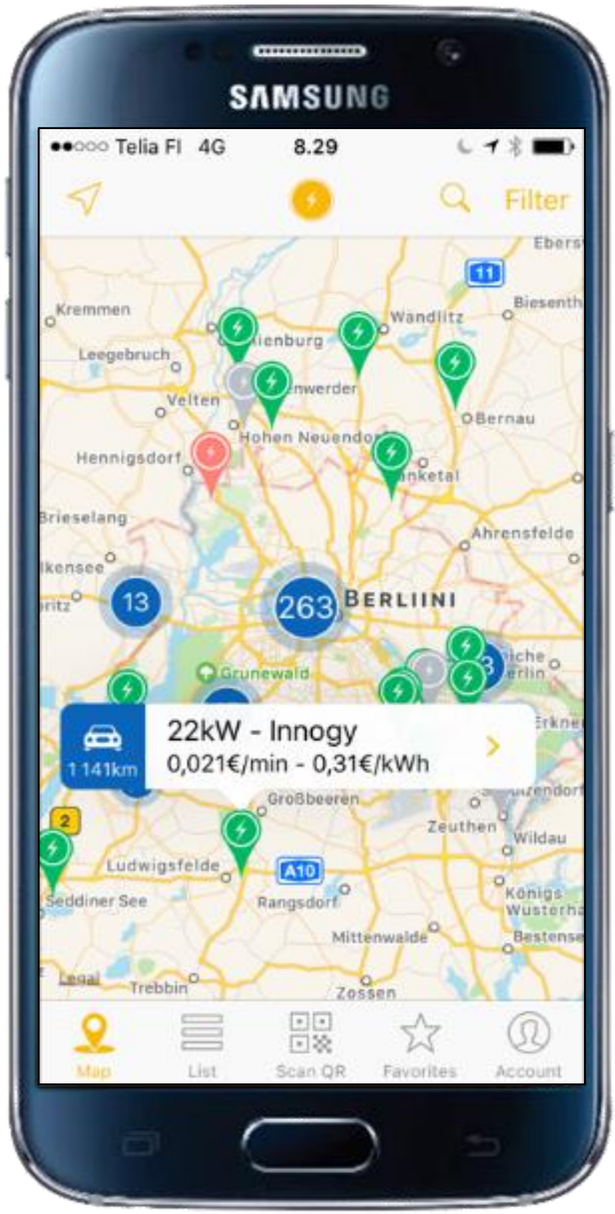
Fortum Charge & Drive and Plugsurfing -making it easy to use electric vehicles

- Fortum Charge & Drive and Plugsurfing join forces to empower drivers to charge wherever they go, even internationally
- Plugsurfing connects already 50 000 electric vehicle drivers to over 200 charging networks and to 60 000 chargers across 24 European countries
- Together we are able to better serve the drivers of electric vehicles, car manufacturers, leasing companies and charge point operators
- As one of the first steps, the Nordic charging network of Charge & Drive will be available on the PlugSurfing application



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Blockchain and Energy – known unknown

No links found in Internet

12/2015

First energy case studies

2/2016

Some energy related innovation challenges

During 2016

Energy Web Foundation introduced

10/2016

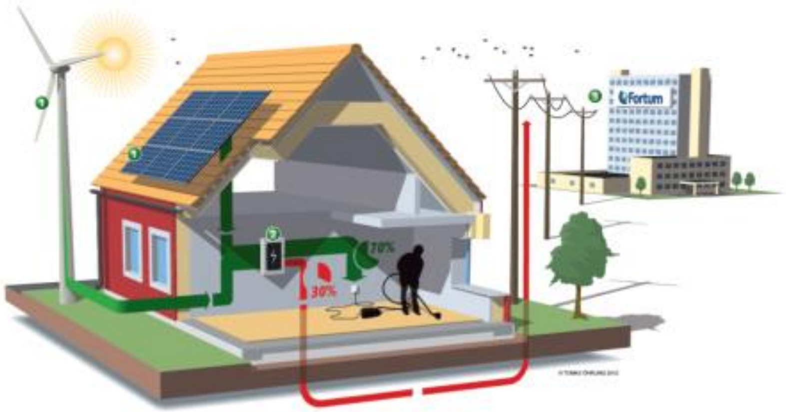
1st European Energy Trade over blockchain

11/2016

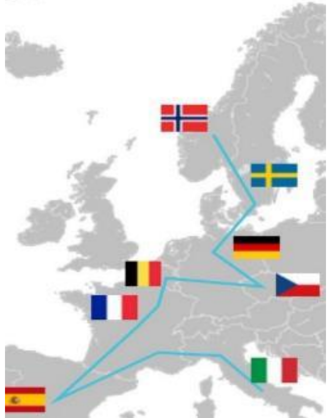
>30 blockchain energy start-ups

Today

Fortum’s first blockchain project - BOND



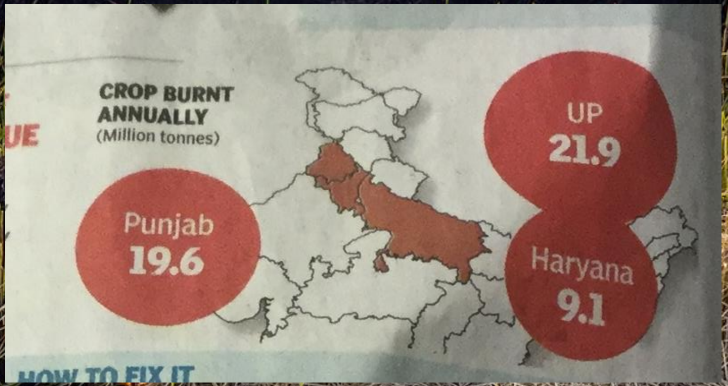
”Oslo2Rome”



WE WORK FOR BIOWENDE

Can we disrupt the
fossil-based industries
in similar way as
solar and wind technology is
disrupting energy?

India - Breathing in Delhi air equivalent to smoking 44 cigarettes a day



100 Biorefinerys

Could replace over 50 % of global cotton production

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Join the change!

@AntilaHeli