Renewable energy developments in the Faroe Islands

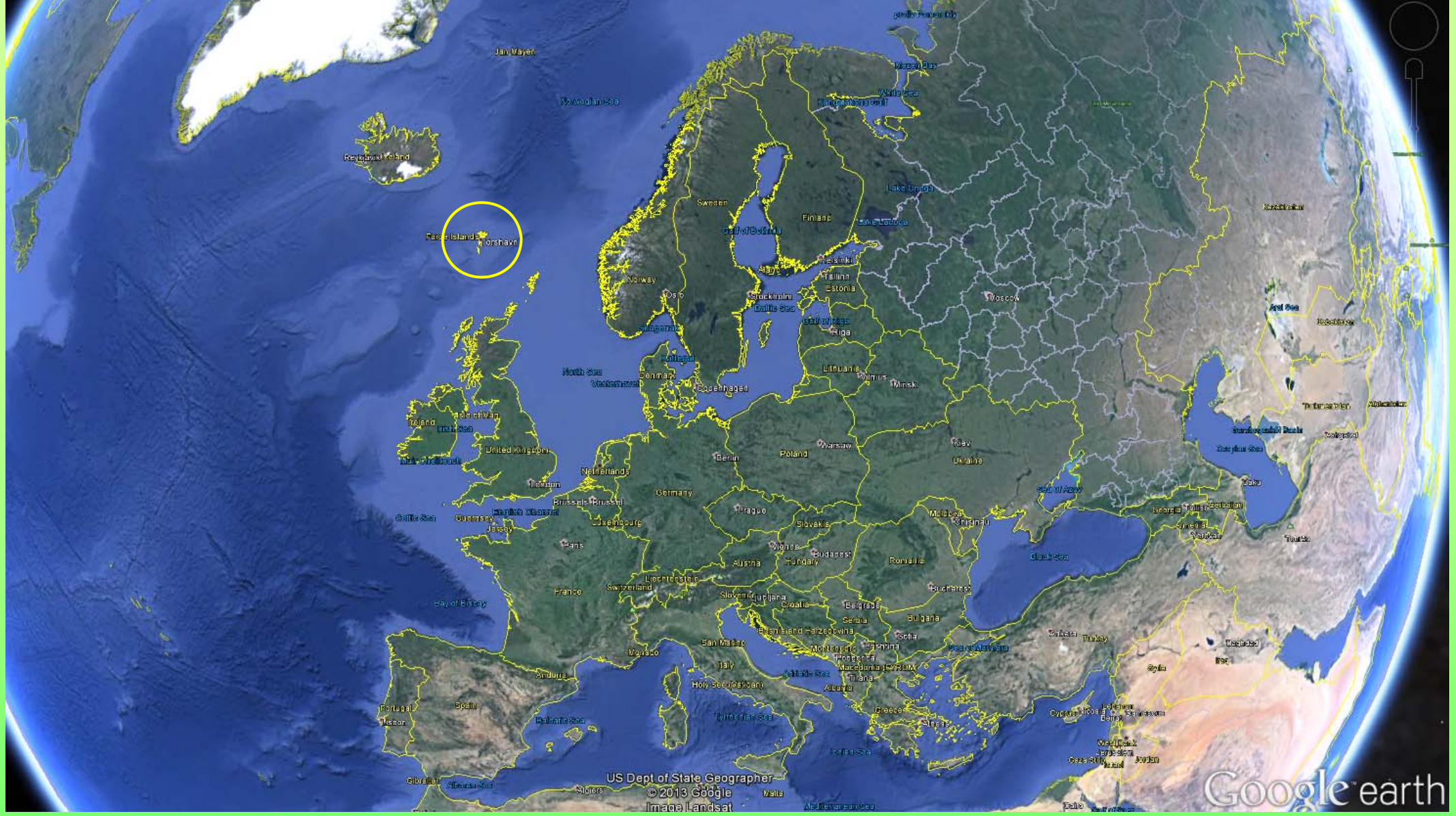
Island Energy – Status and Perspectives

Tokyo, 6 October 2015

Jarðfeingi - **Bjarti Thomsen**

Overview

Faroe Islands
Energy demand and generation
Wind developments
Electrification
Energy storage



Faroe Islands

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Renewables: rain, wind, sun, sea

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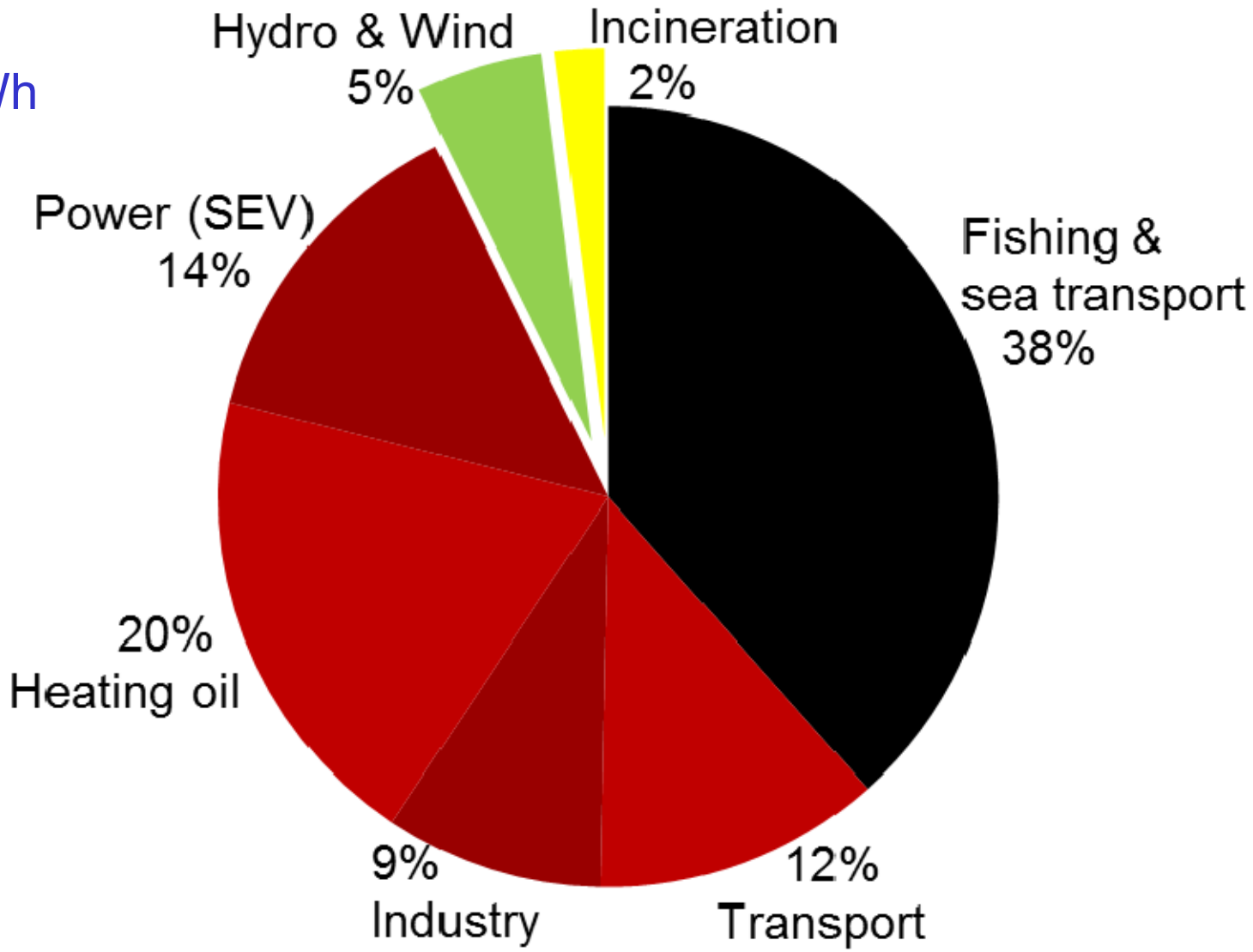
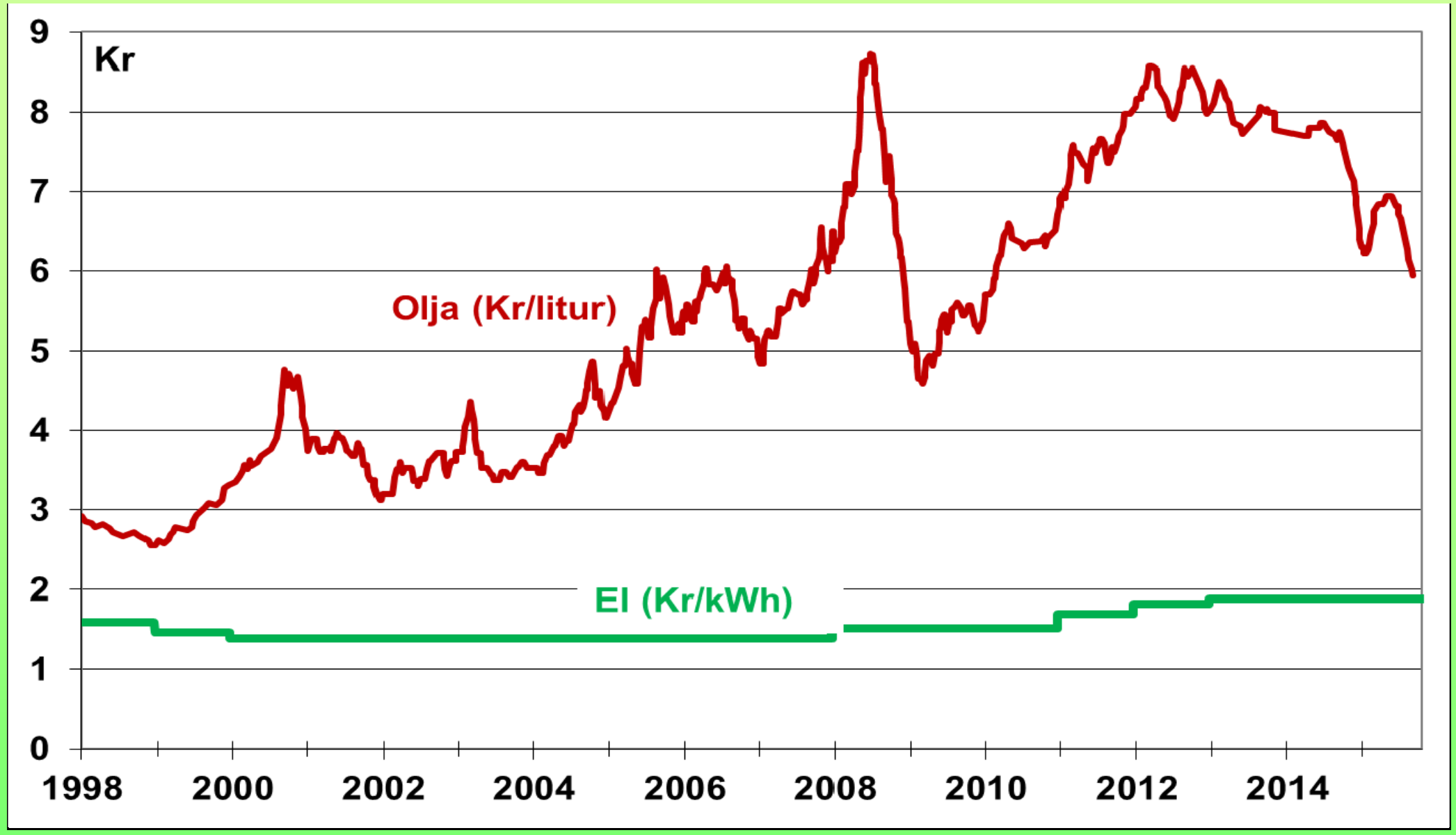
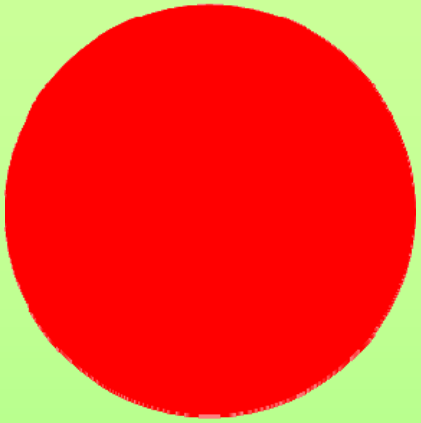
Power
~300 GWh



Total 2014: 3.000 GWh

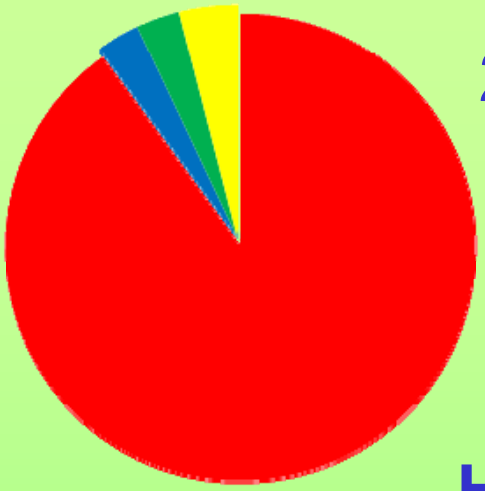


Family house use 3.000 litre oil per year for heating.



Heating

(oil-burners)

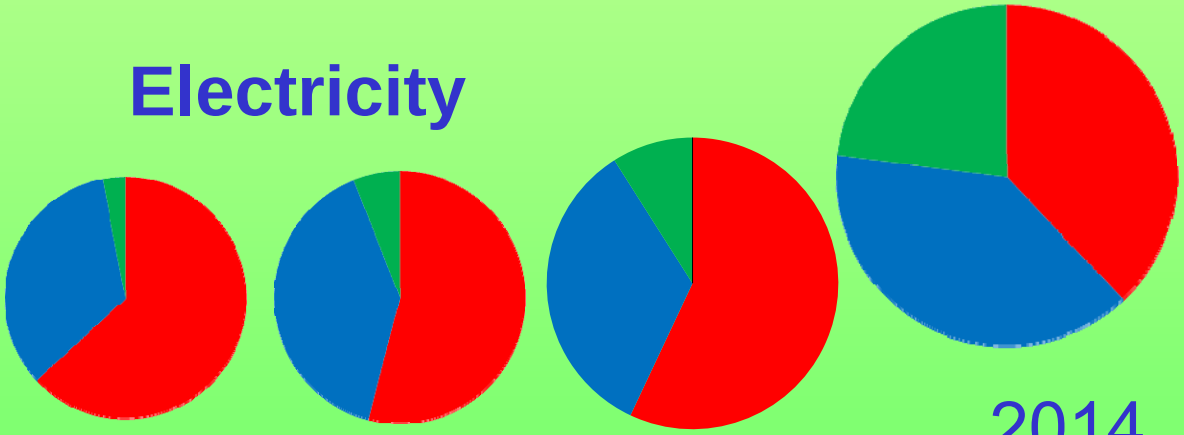


20.000 oil-burners

Oil Hydro Wind Other

Heating 600 GWh

Electricity



2003 2005 2012 2014

Electricity 310 GWh

Government policy is to expand wind power and electrify heating

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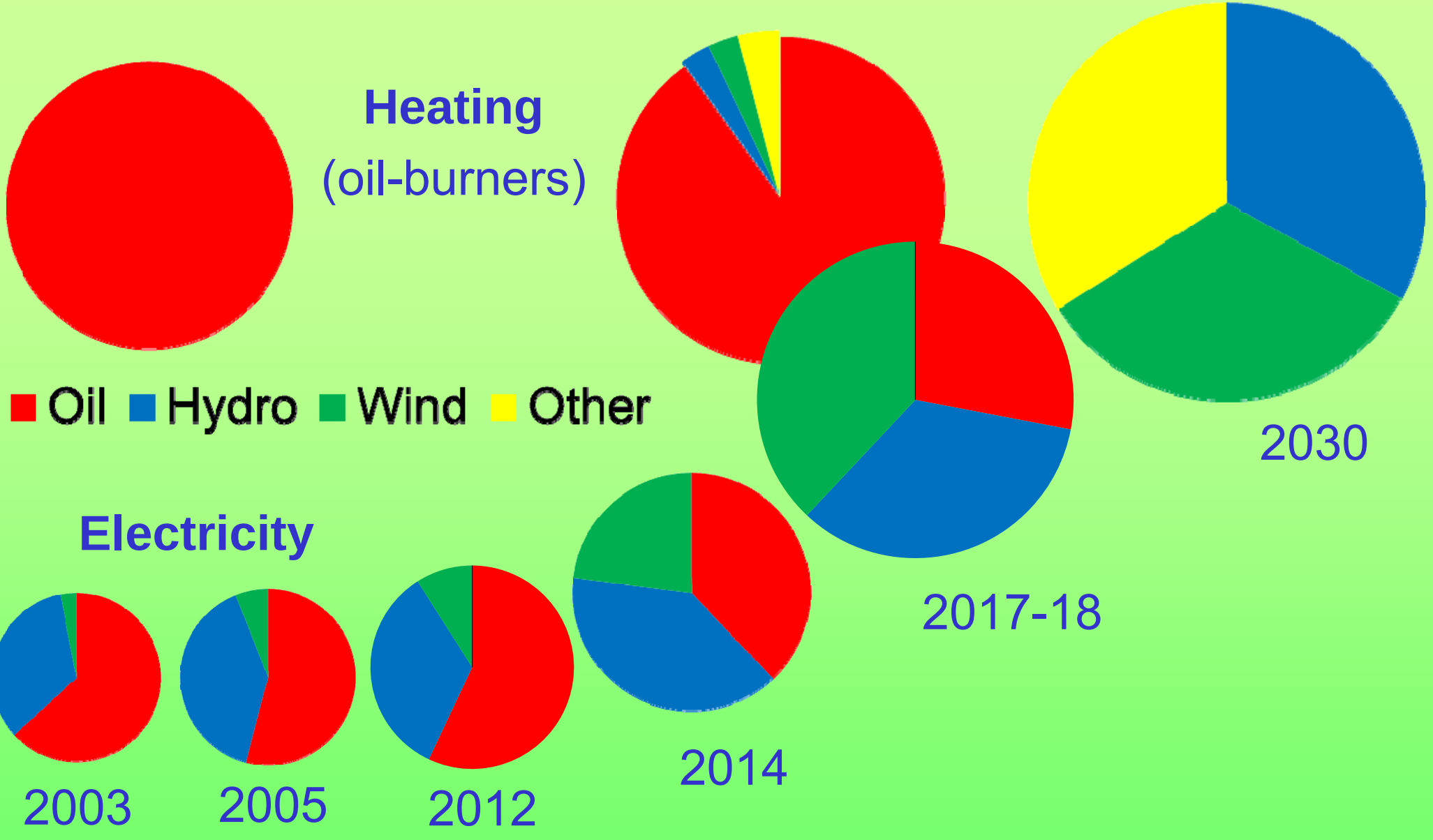

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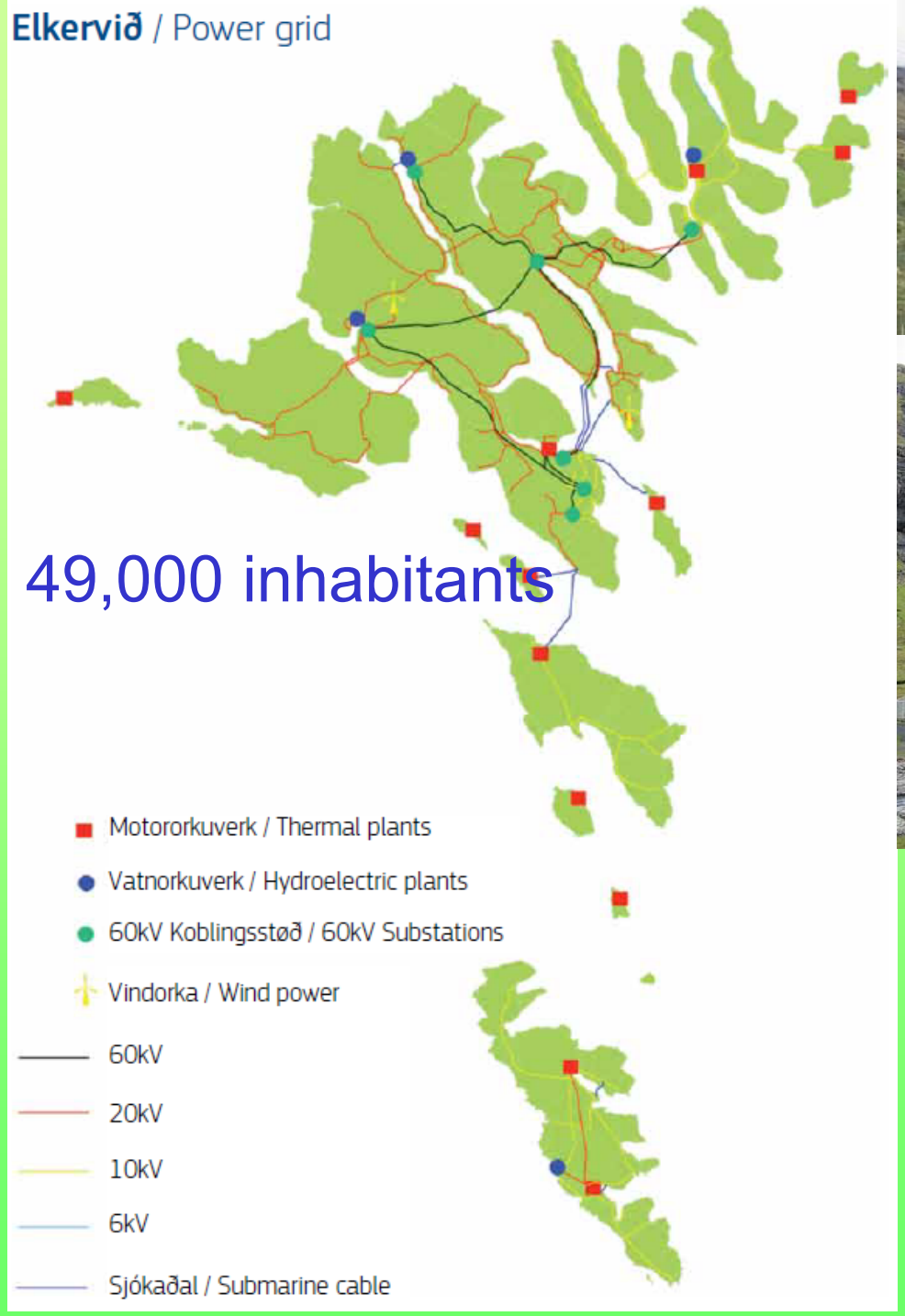

49,000 inhabitants

Thermal
66 MW
181 GWh

Hydro
39 MW
100 GWh

Wind
6 MW => 18MW
11 GWh => 70 GWh

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Hydropower – environmental impact

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2012: 5 new Enercon E44 900kW = 4.5MW, total 6.6MW

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2014: 13 new Enercon E44 900kW = 11.7MW, total 18.3MW

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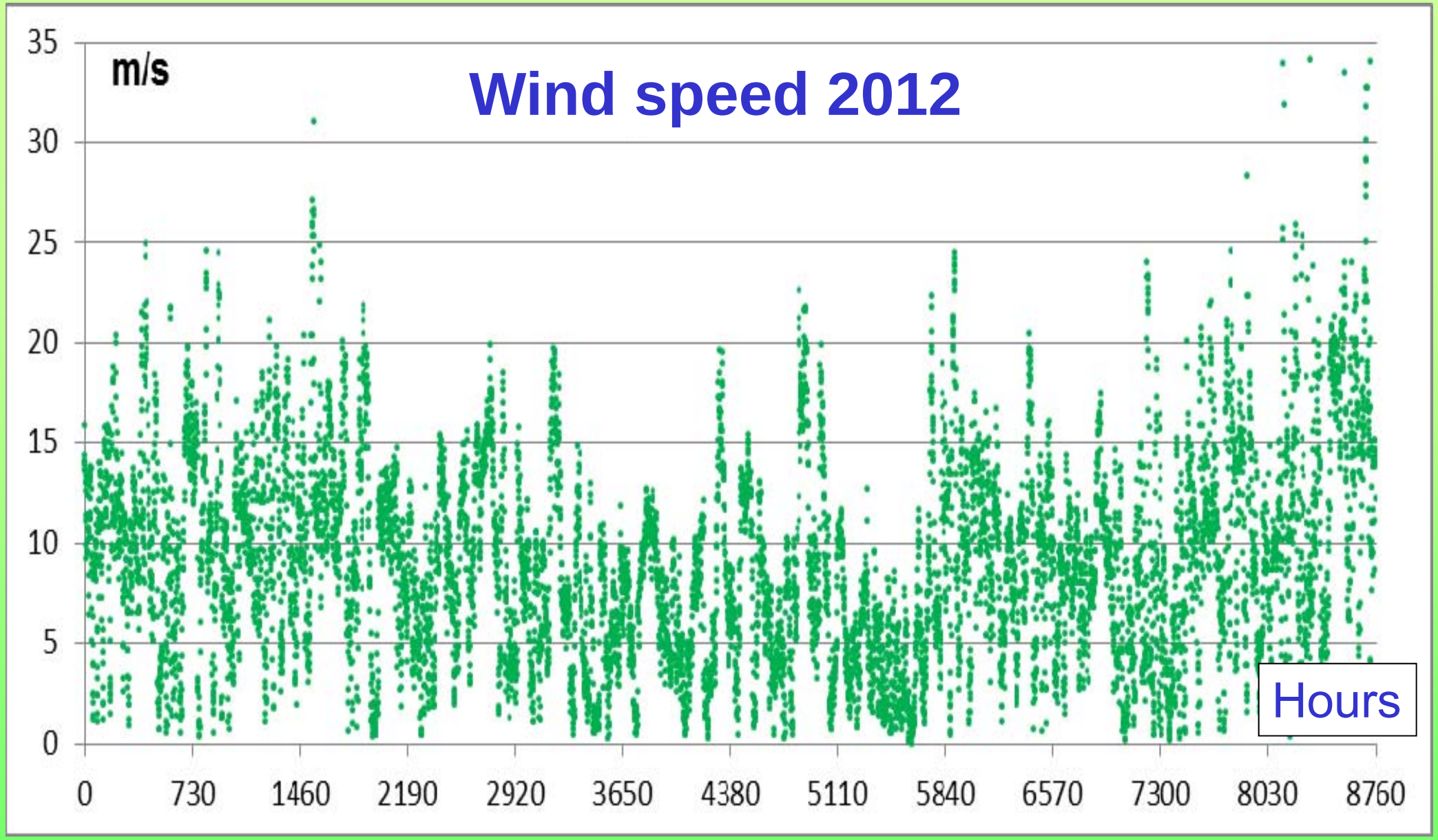

Average wind speed 10 m/s

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Wind on the grid ~ 80%

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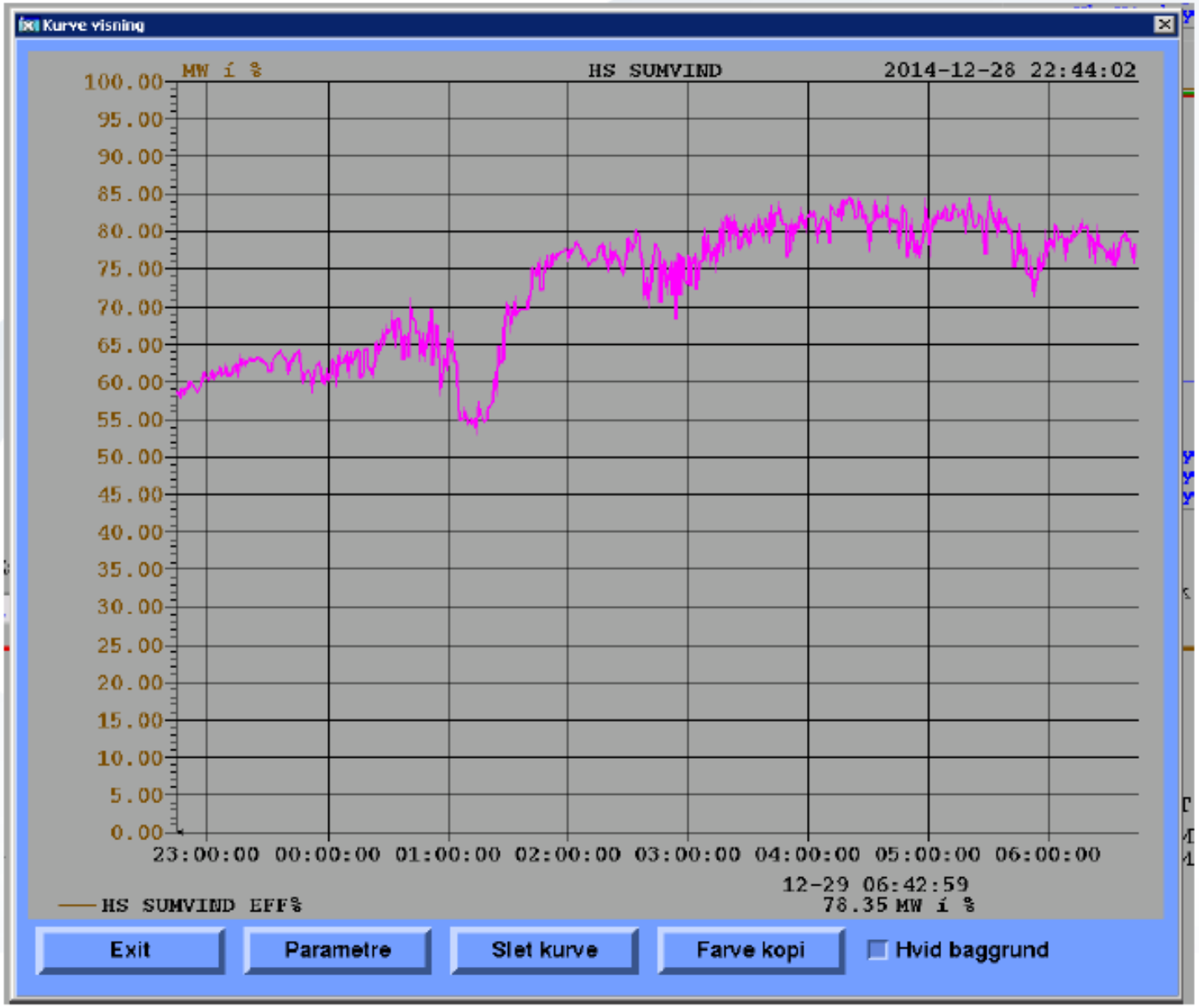
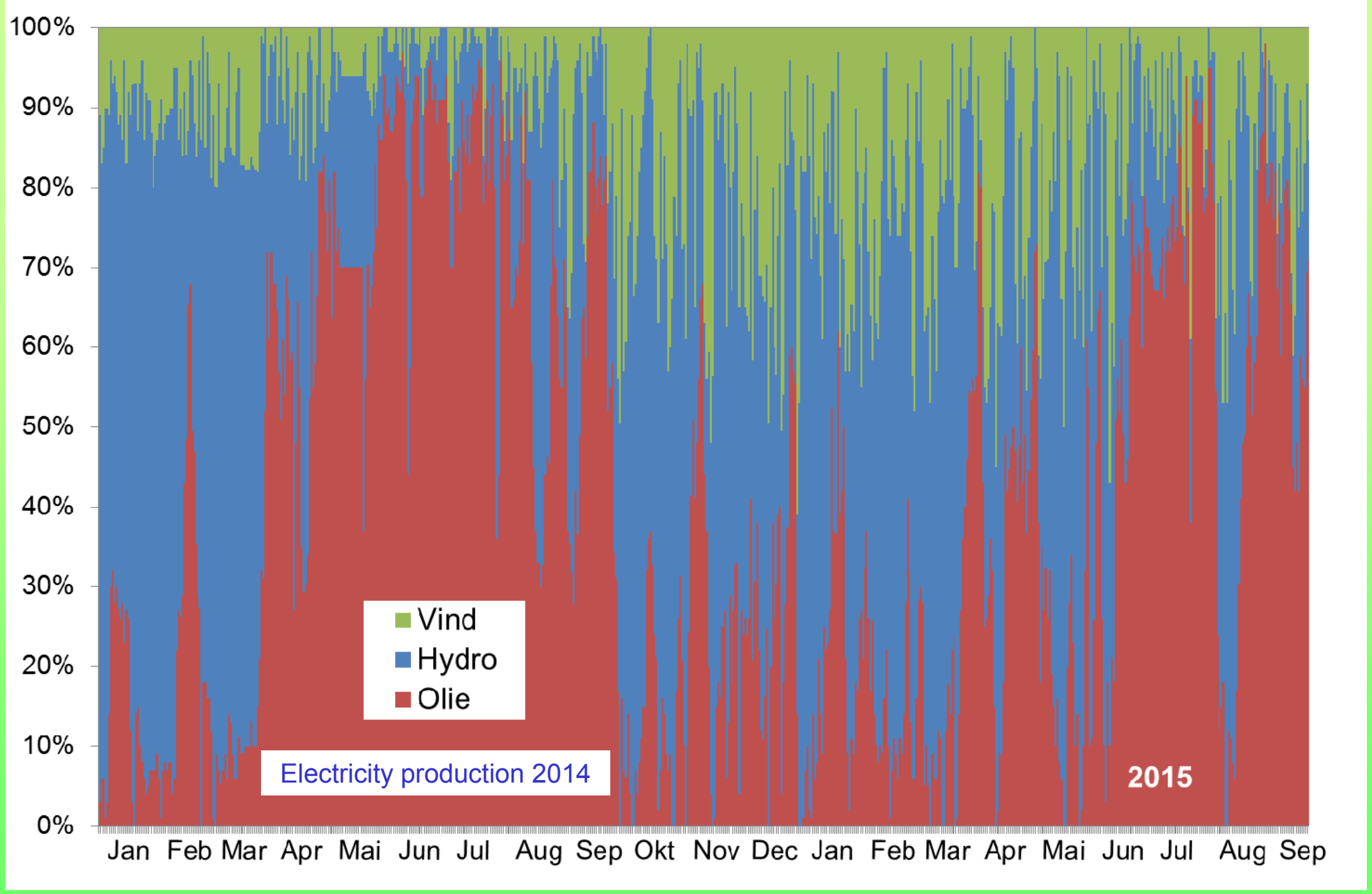
>80% wind penetration for hours





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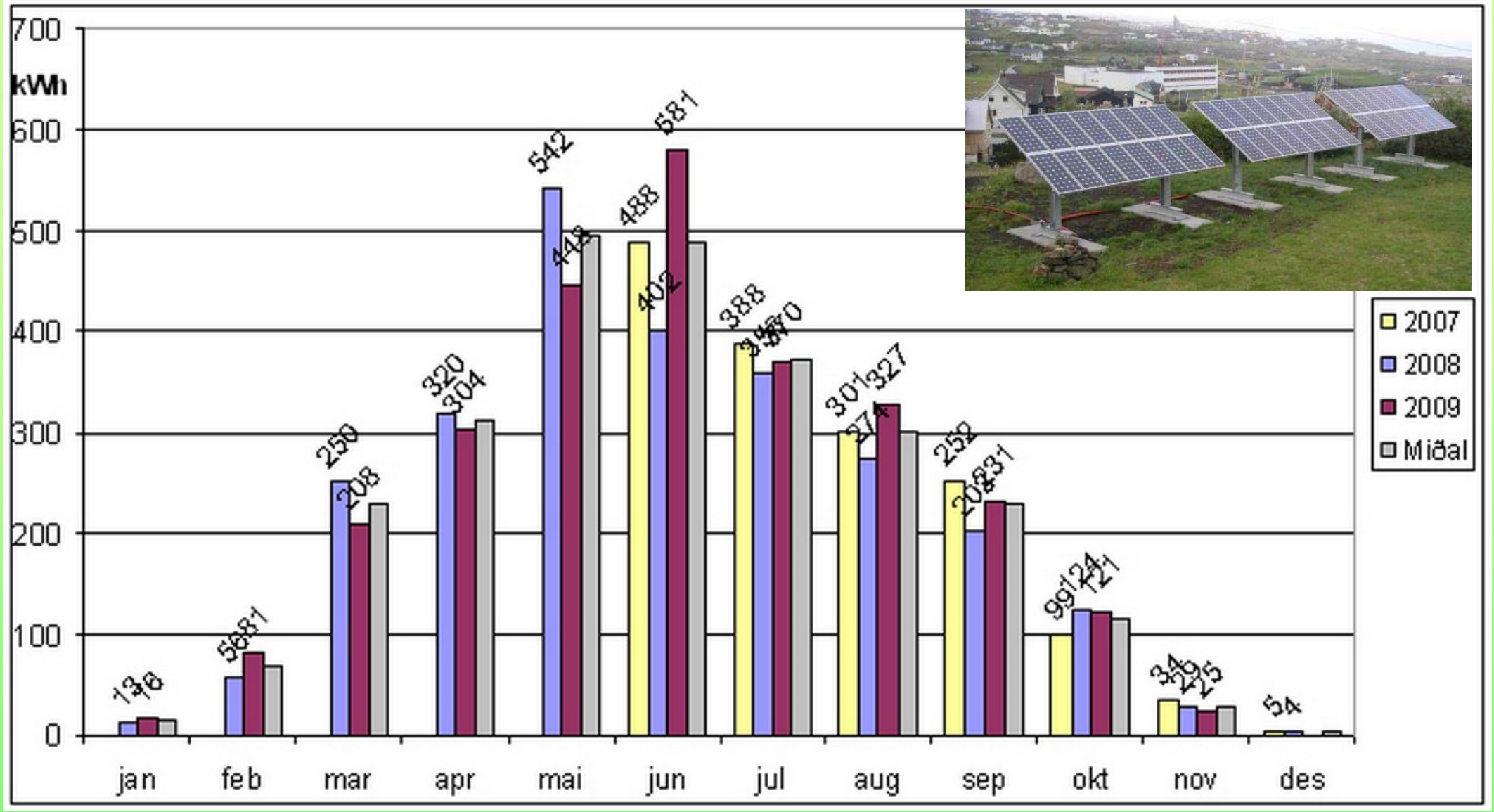

Tórshavn (www.vh.fo): 31.5m^2, 4080W

Solar-energy opposite to wind and hydro

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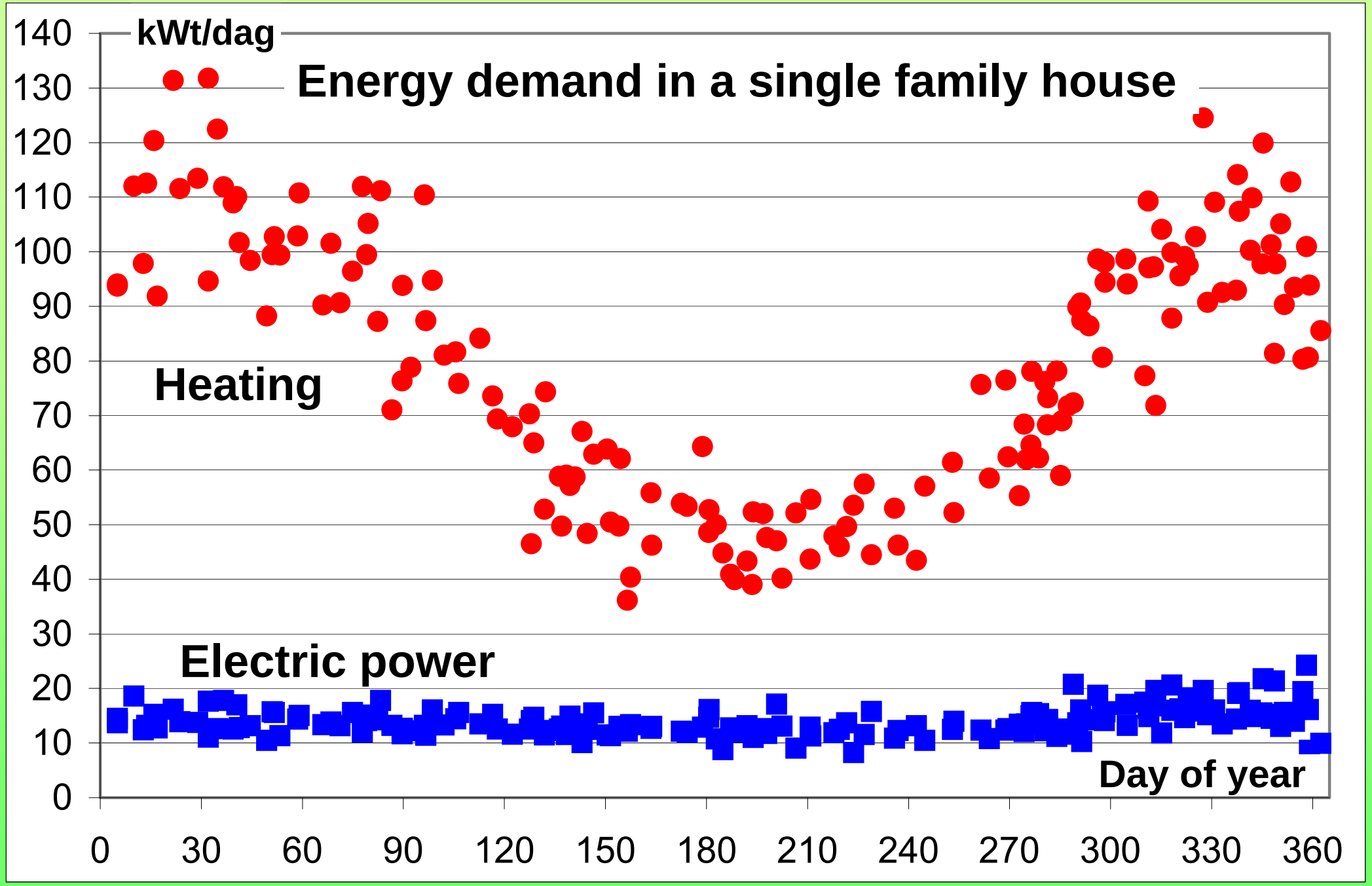
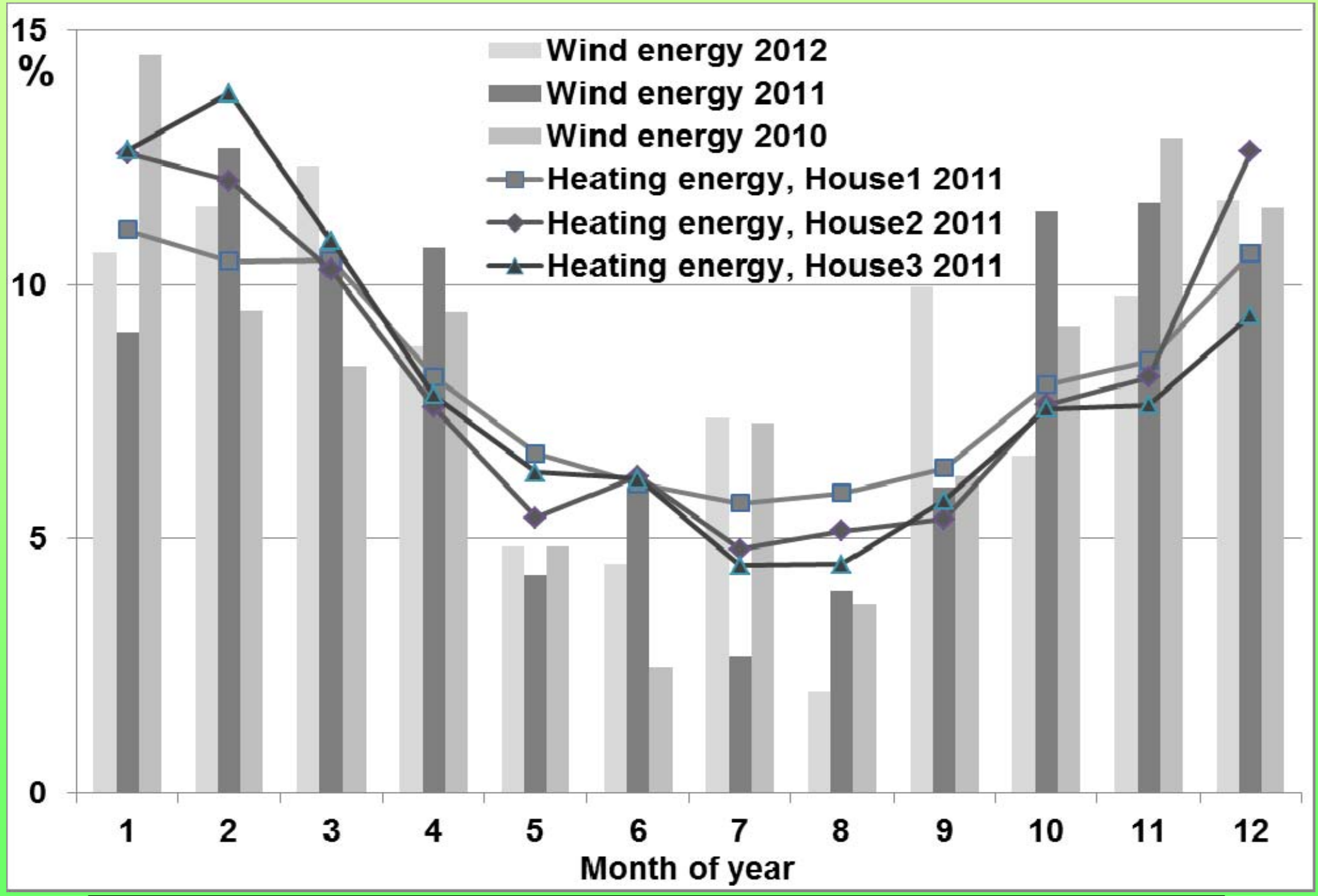

kWt/dag
Energy demand in a single family house
Heating
Electric power
Day of year
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
30
60
90
120
150
180
210
240
270
300
330
360



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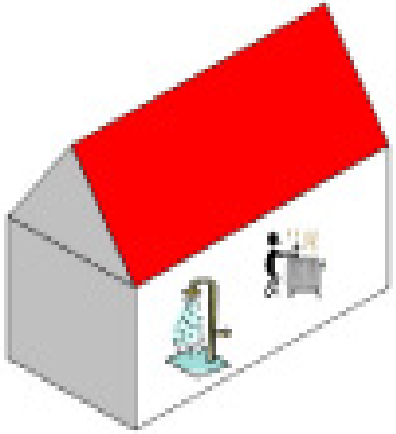
Heat pumps



Q: Hiti inn í húsið
30°C - 90°C

100%

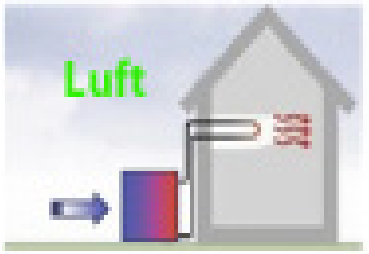
Hitapumpa

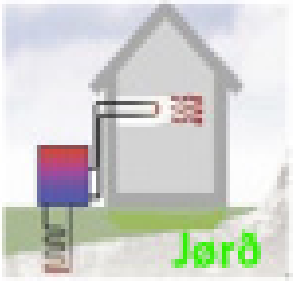
P: El-orka frá SEV

20% - 50%

Hiti frá umhverfinum

50% - 80%





Hiitakelda
-5°C -12°C

COP: (Coefficient Of Performance)= $\frac{Q}{P}$

Q	P	$\frac{Q}{P}$
100%	20%	5
100%	25%	4
100%	30%	3,3

District heating

Sea temp.
6°C - 11°C

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Wind turbine 220kW heating 35 houses

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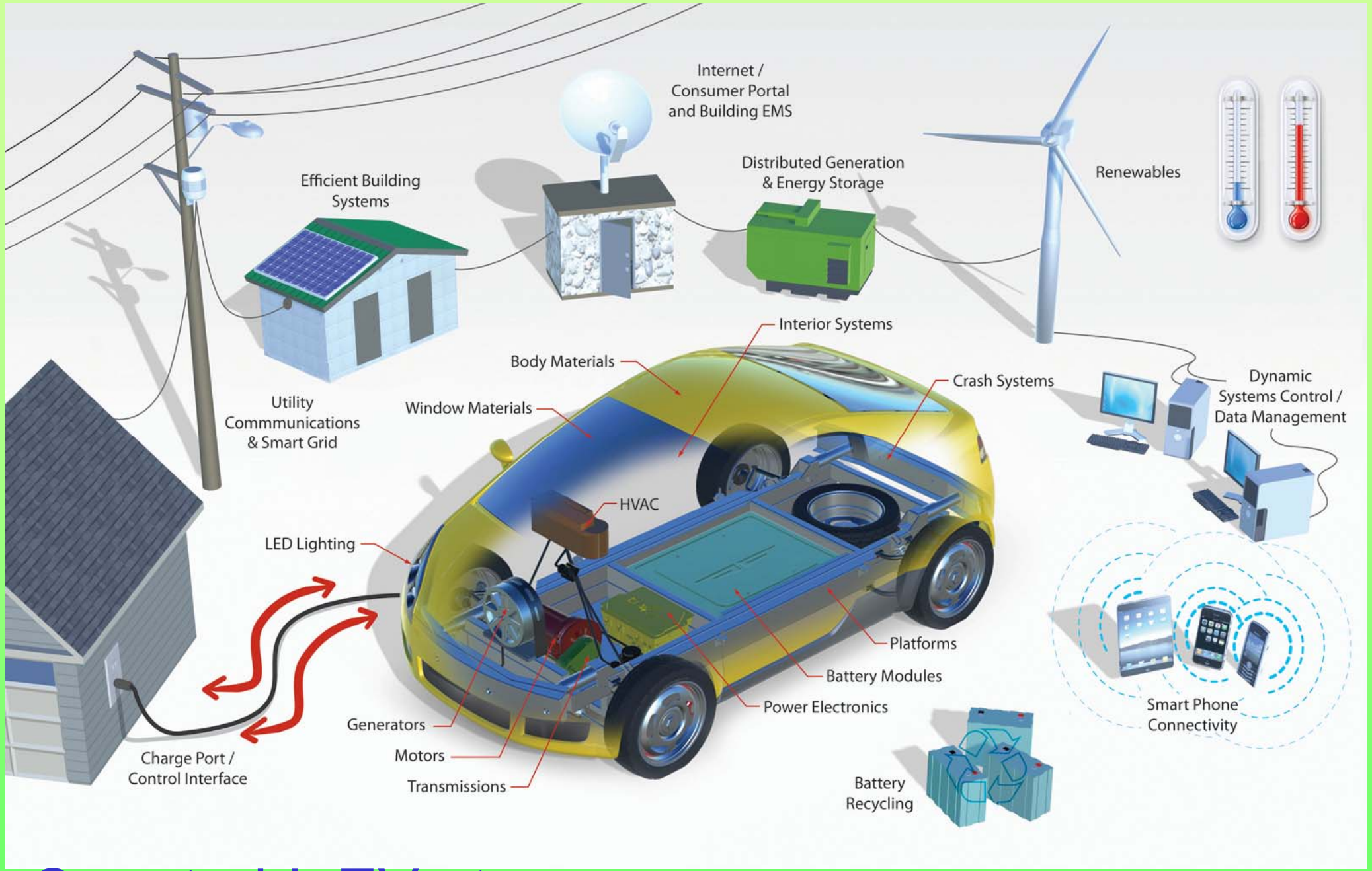

Smartgrid, EV etc.

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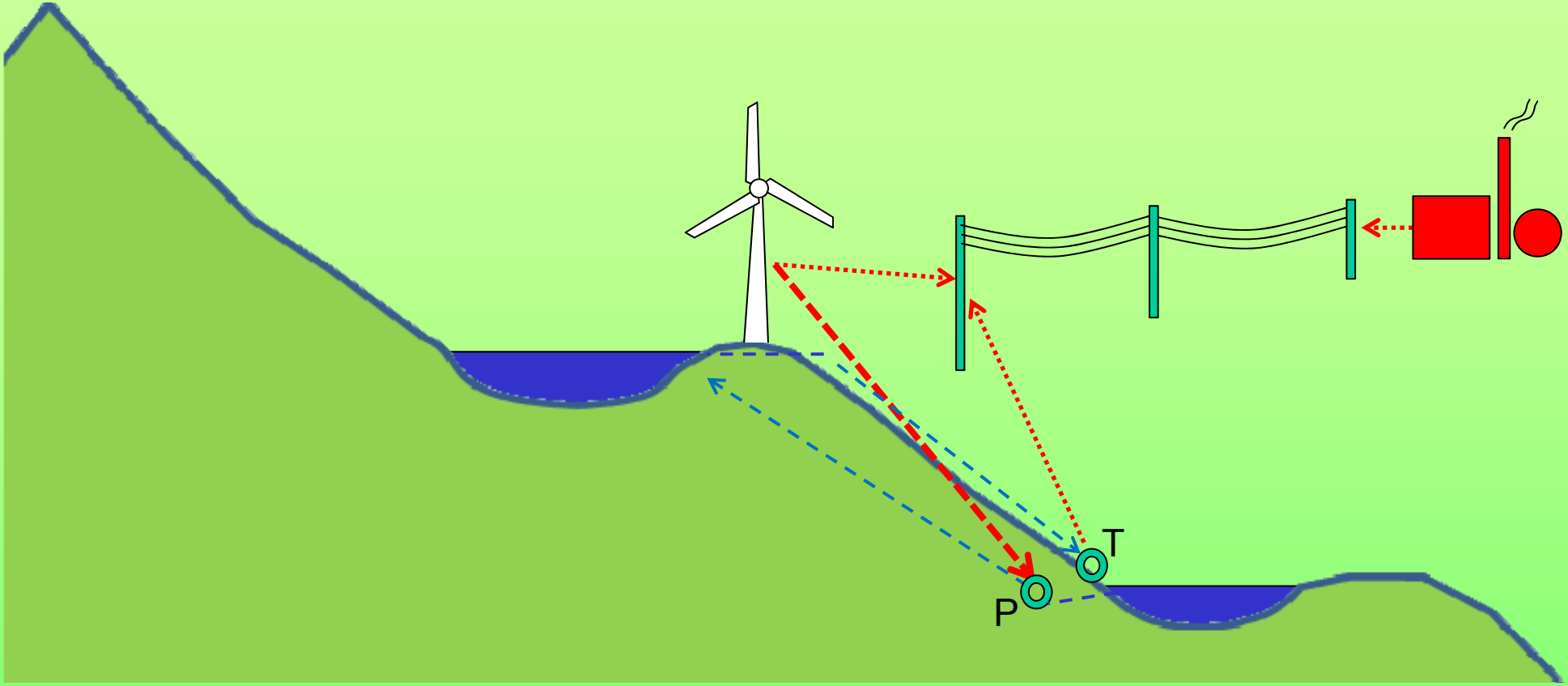
Wind - pumped – hydro - storage



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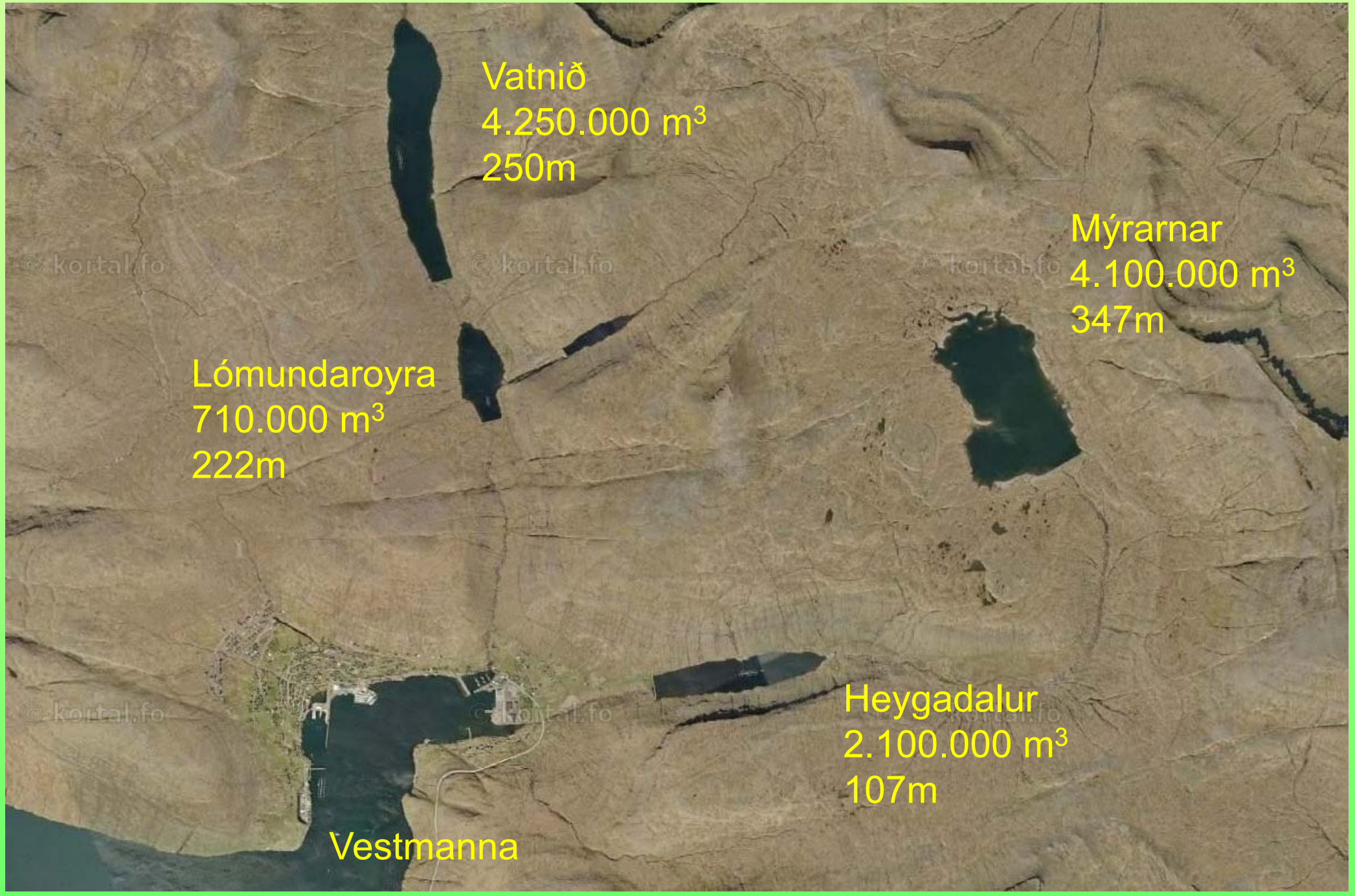

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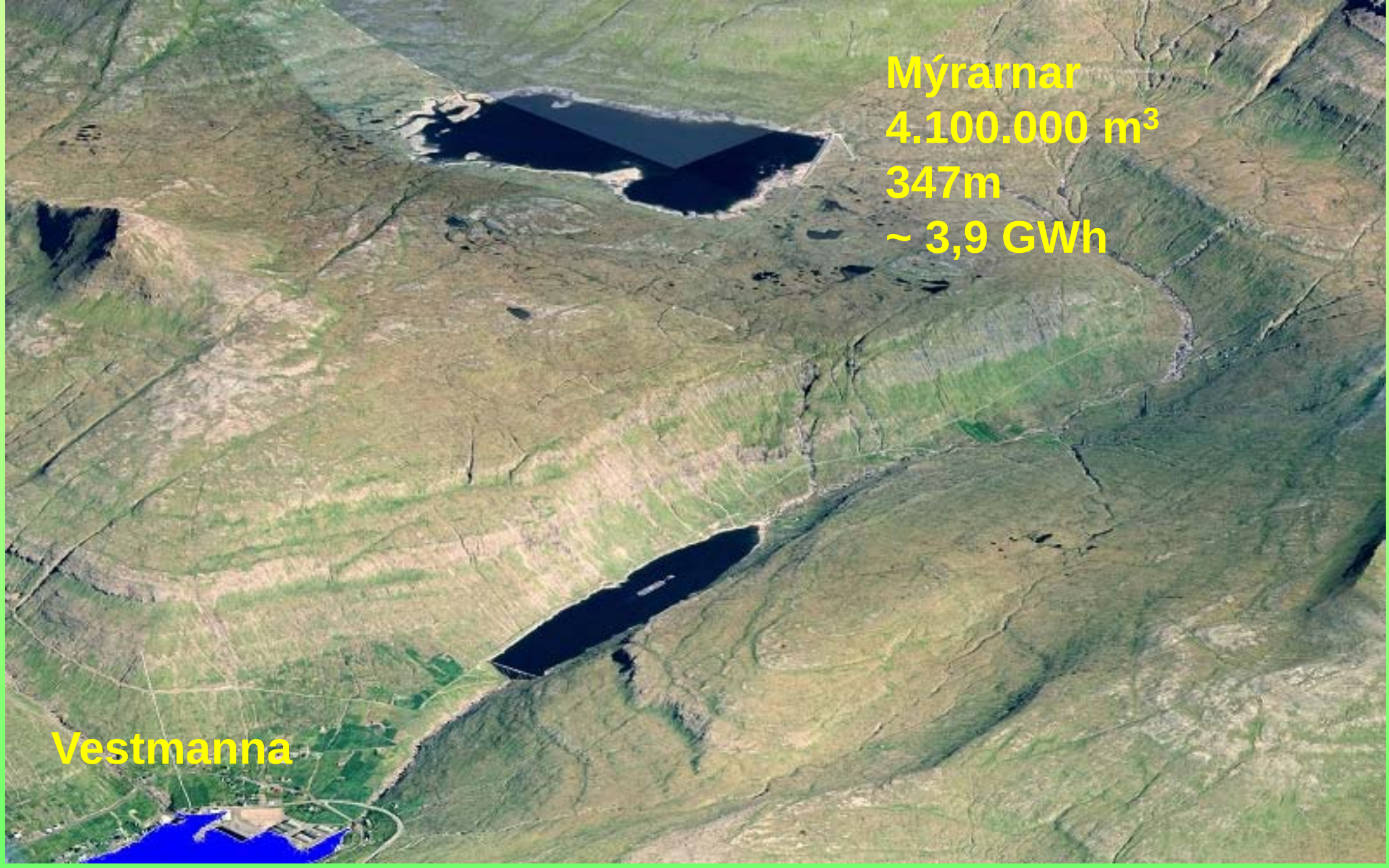
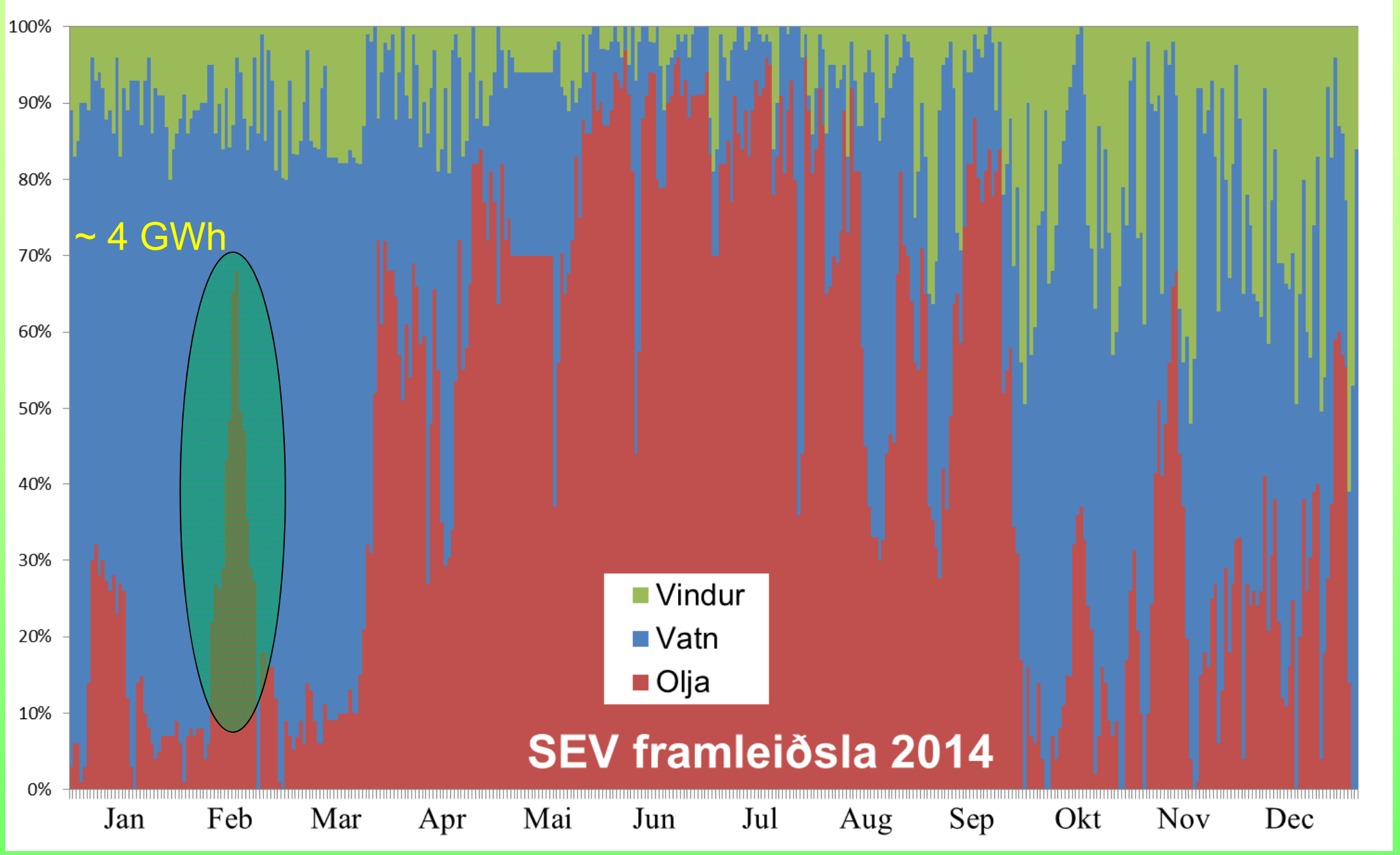
$E_p = m\ g\ h$

$1000 \times 9{,}8 \times 400 \quad \sim 1\text{kWh}$


Mýrarnar
4.100.000 m3
347m
~ 3,9 GWh
Vestmanna



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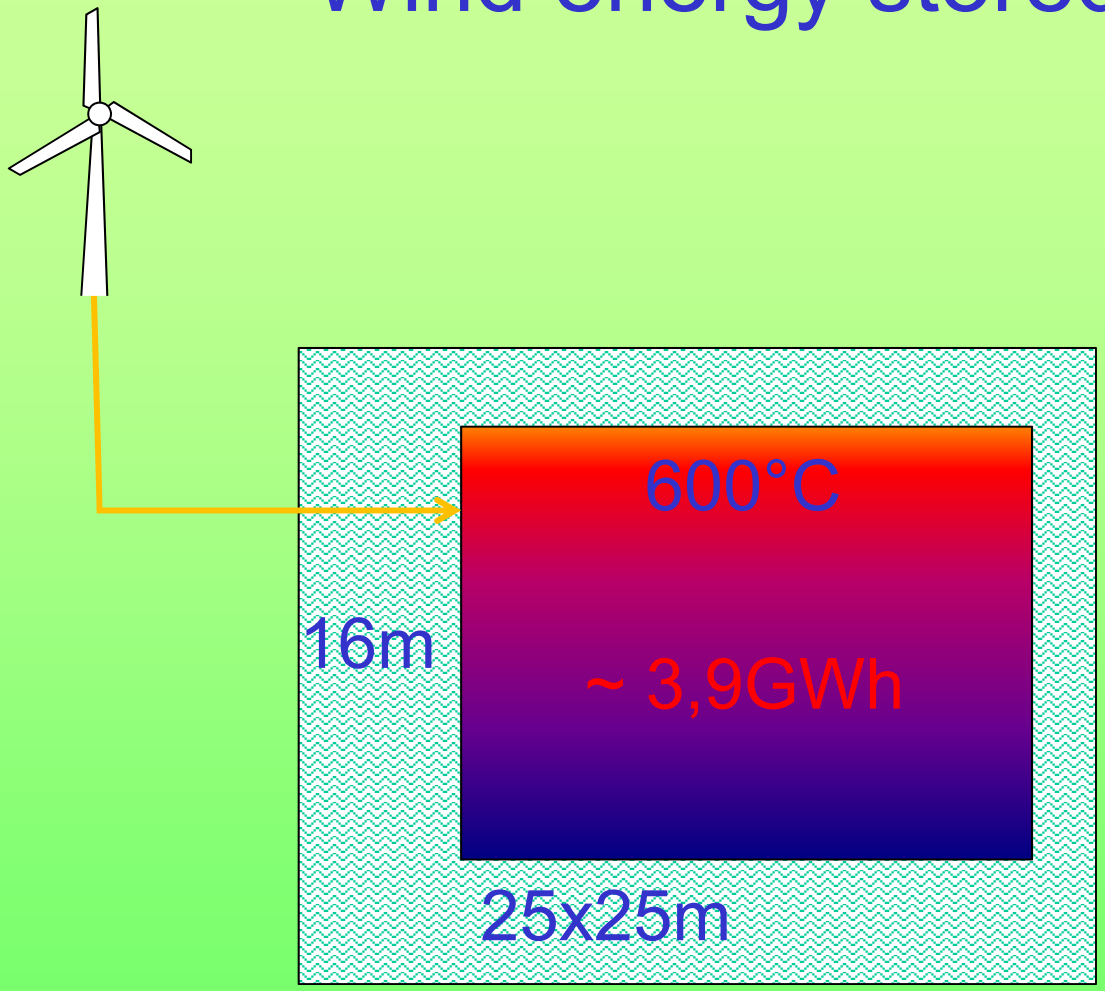
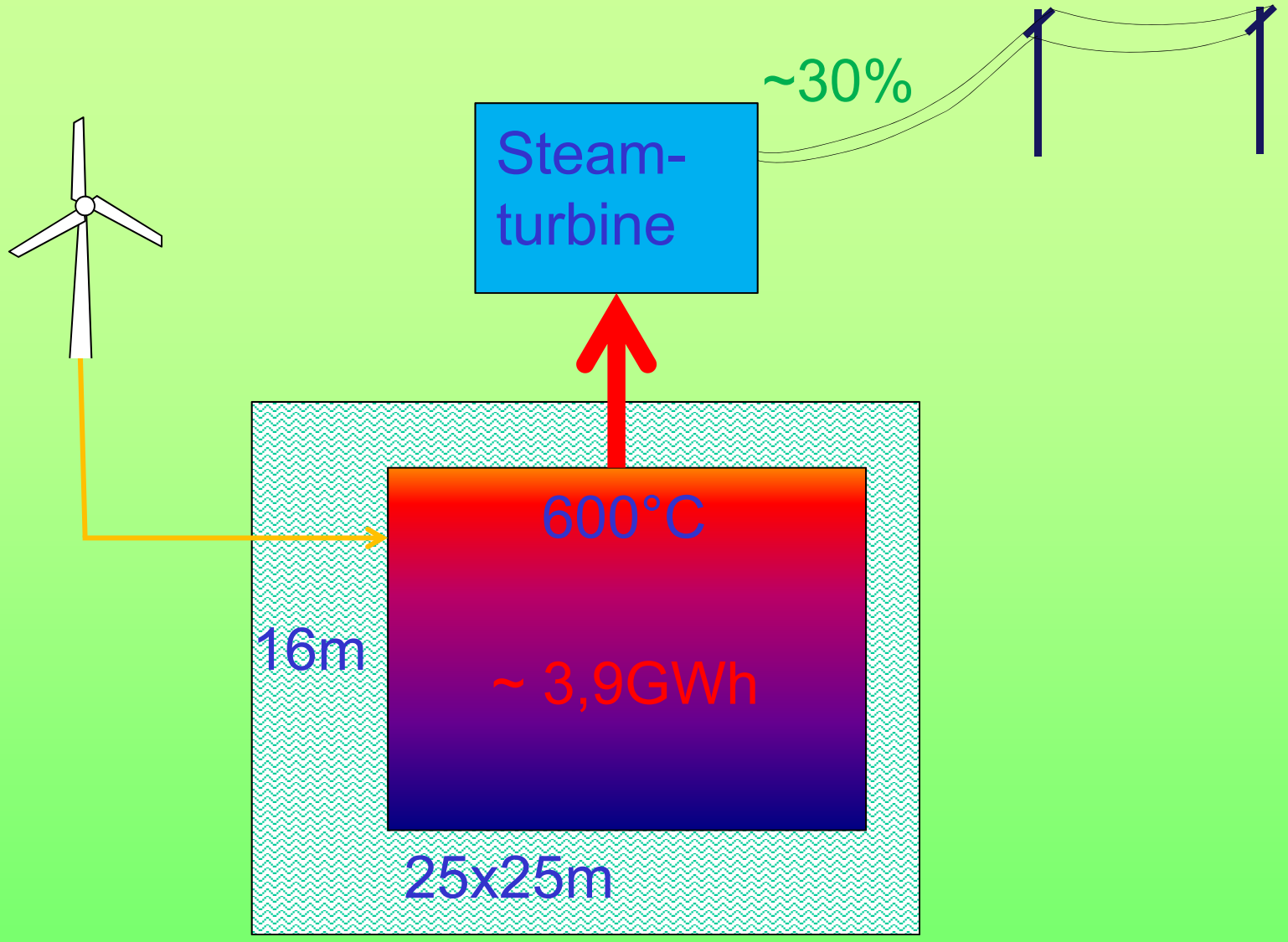
$E_p = m\ g\ h$ $1000 \times 9{,}8 \times 400$ ~ 1kWh

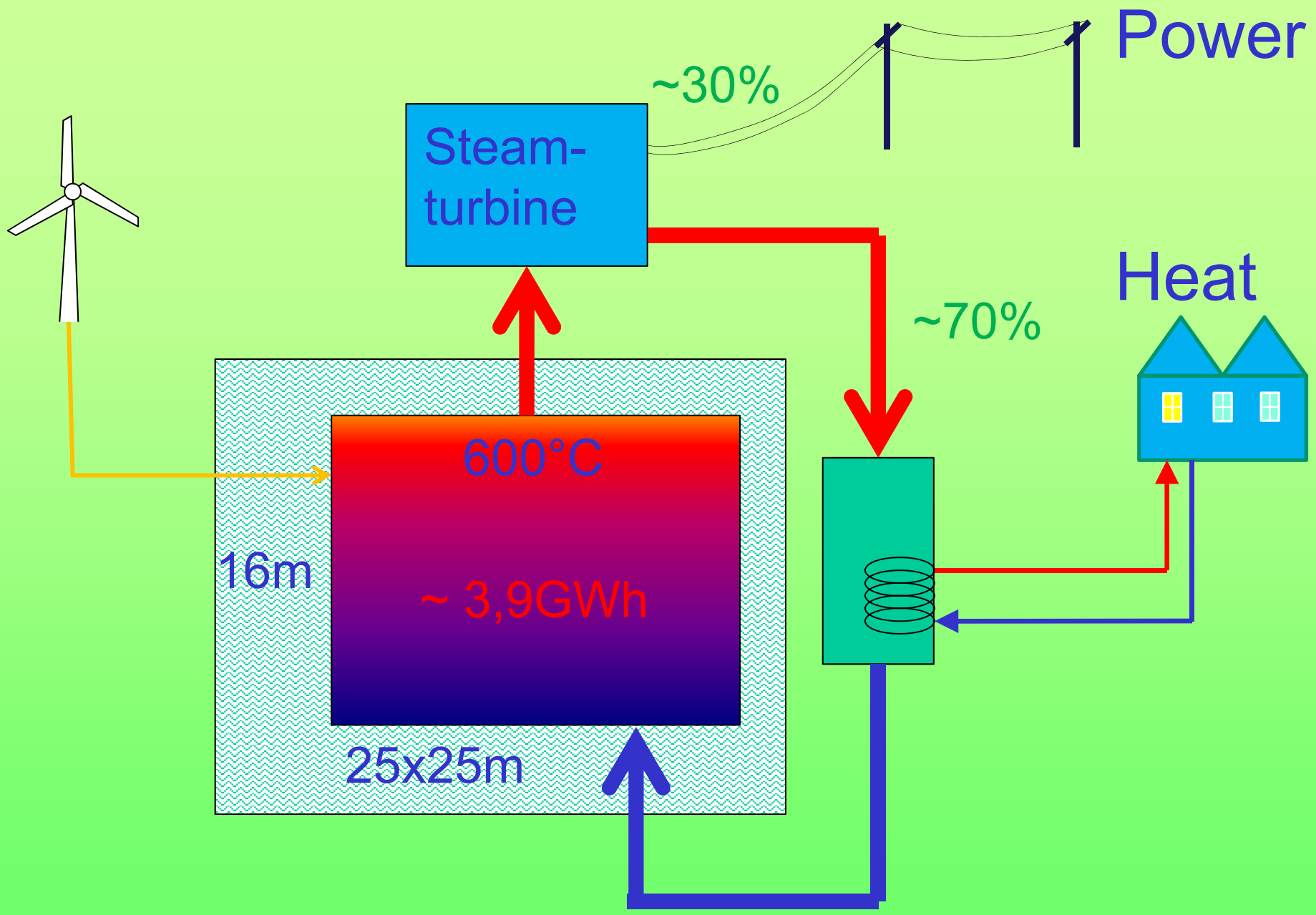
$E_t = m\ C_p\ \Delta T$ $1000 \times 4200 \times 1$ ~ 1kWh

Energy storage in water:
400m height ~ 1°C heat

Wind energy stored as heat




~30%
Steam-
turbine
600°C
~ 3,9GWh
16m
25x25m


Power
~30%
Steam-
turbine
Heat
~70%
600°C
16m
~ 3,9GWh
25x25m

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NEST
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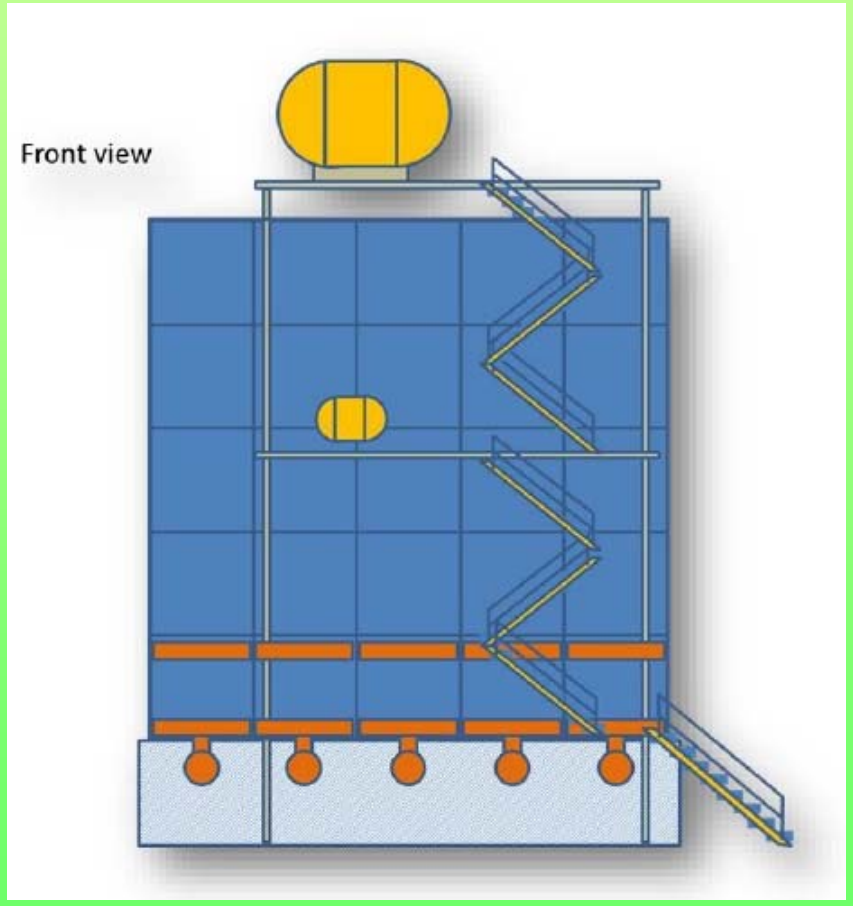
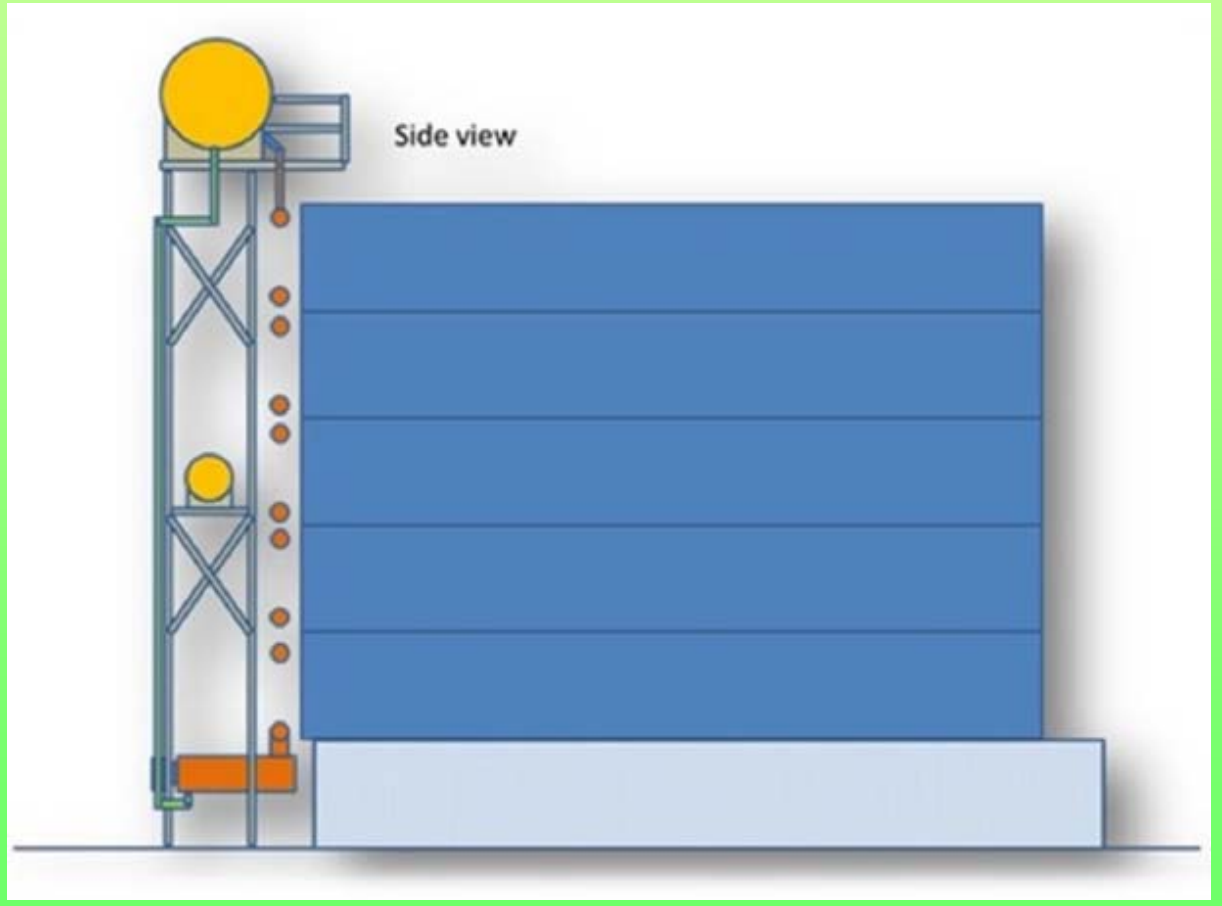
Steam Concrete Storage Technology





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Resumé

Develop renewables (wind)

Heating electrified => Electric power increase (x2)

Wind and hydro annual variation,
corresponds to heating demand

Intermittency => Energy storage

Pumped Hydro Storage opportunities

Thermal Storage is effective

Flexible load - demand response

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