SMALL-SCALE GEOTHERMAL POWER FOR OFF-GRID COMMUNITIES IN INDONESIA

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GEOCAP

Why small scale geothermal power?

Geothermal power plants are large for a reason

Mainly due to the inherent economies of scale

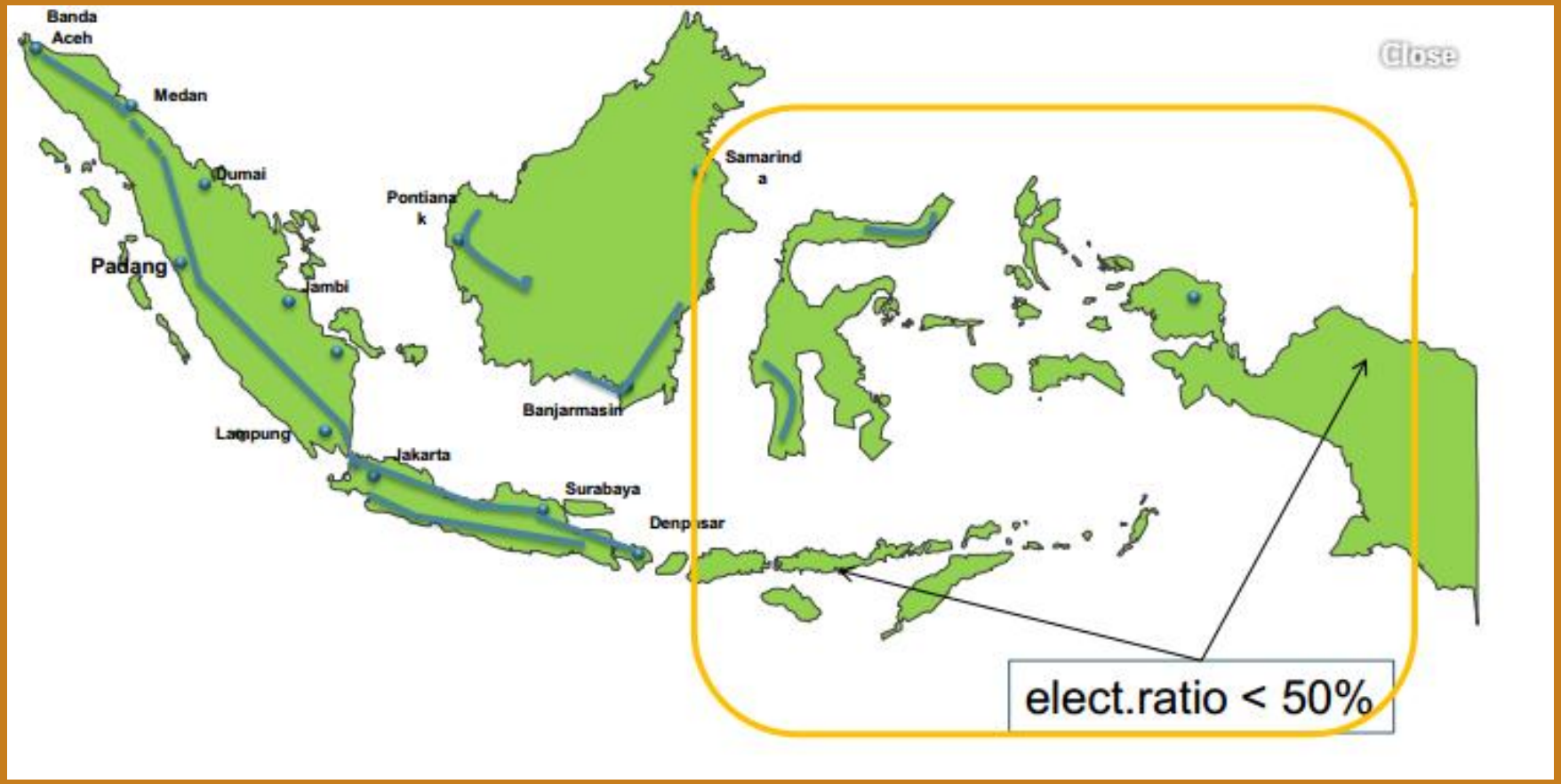
Geothermal power capital costs by project development phase (USD/kW)

	200 kW binary plant	20 MW binary plant	50 MW flash plant
Exploration	300	320	240
Confirmation	400	470	370
Main wells	800	710	540
Field, other costs	120	120	60
Power plant	4,250	2,120	1,080
Contingency	880	190	120
Total costs	6,750	3,930	2,410

Source: World Bank, 2005c.

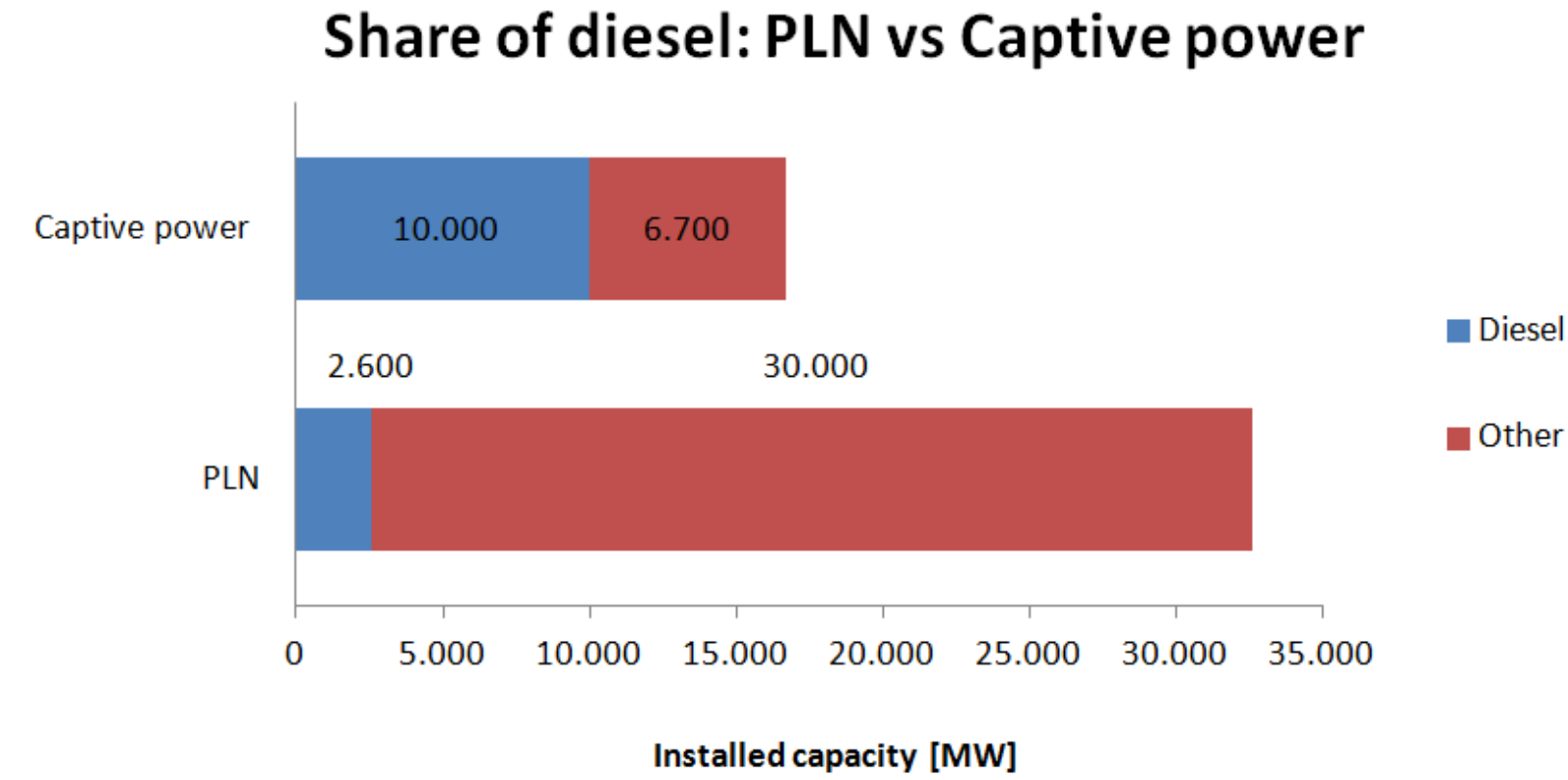
But large power plants also require large electricity grids

And indonesia is a very large country with many small and remote islands



This leaves many relying on dirty and expensive diesel generators

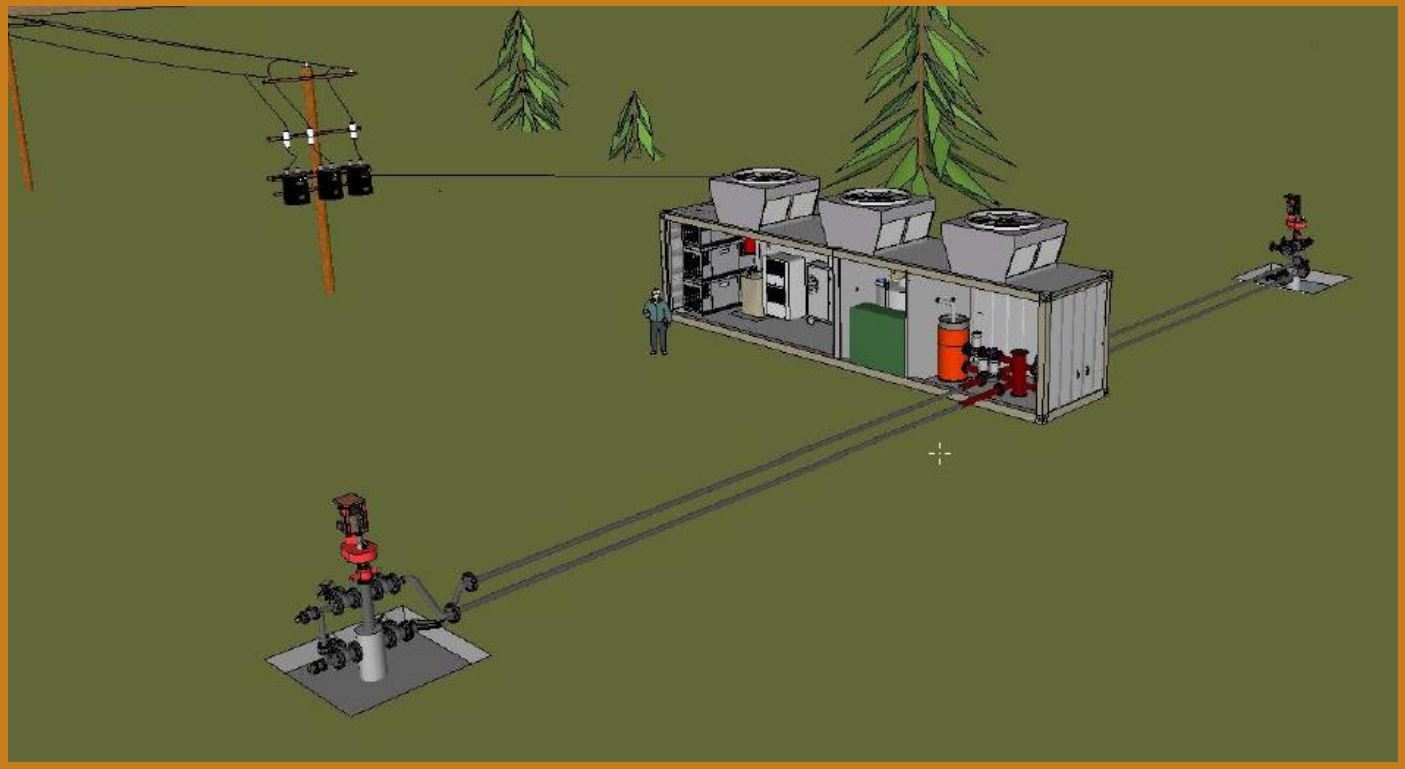
With a significant share in the total power production



Source: PLN statistics 2009 & 2012

Even though there is often good potential for geothermal energy

This is where a small geothermal plant can be useful



What we designed: MiniGeo

- A modular geothermal powerplant fitted in a 40 foot shipping container
- base load power
- Does not need fuel
- Remote operation through sattelite link
- Near-zero marginal costs
- No CO_2 emissions
- Secondary outputs

Secondary output modules

- Drinking water (desalination or aquifer based)
- Cooling / Ice production
- Communication (Internet, mobile network, 3G/4G, Radio, Television)
- Crop drying/processing
- Waste(water) treatment
- Bathing, laundry, hotspring

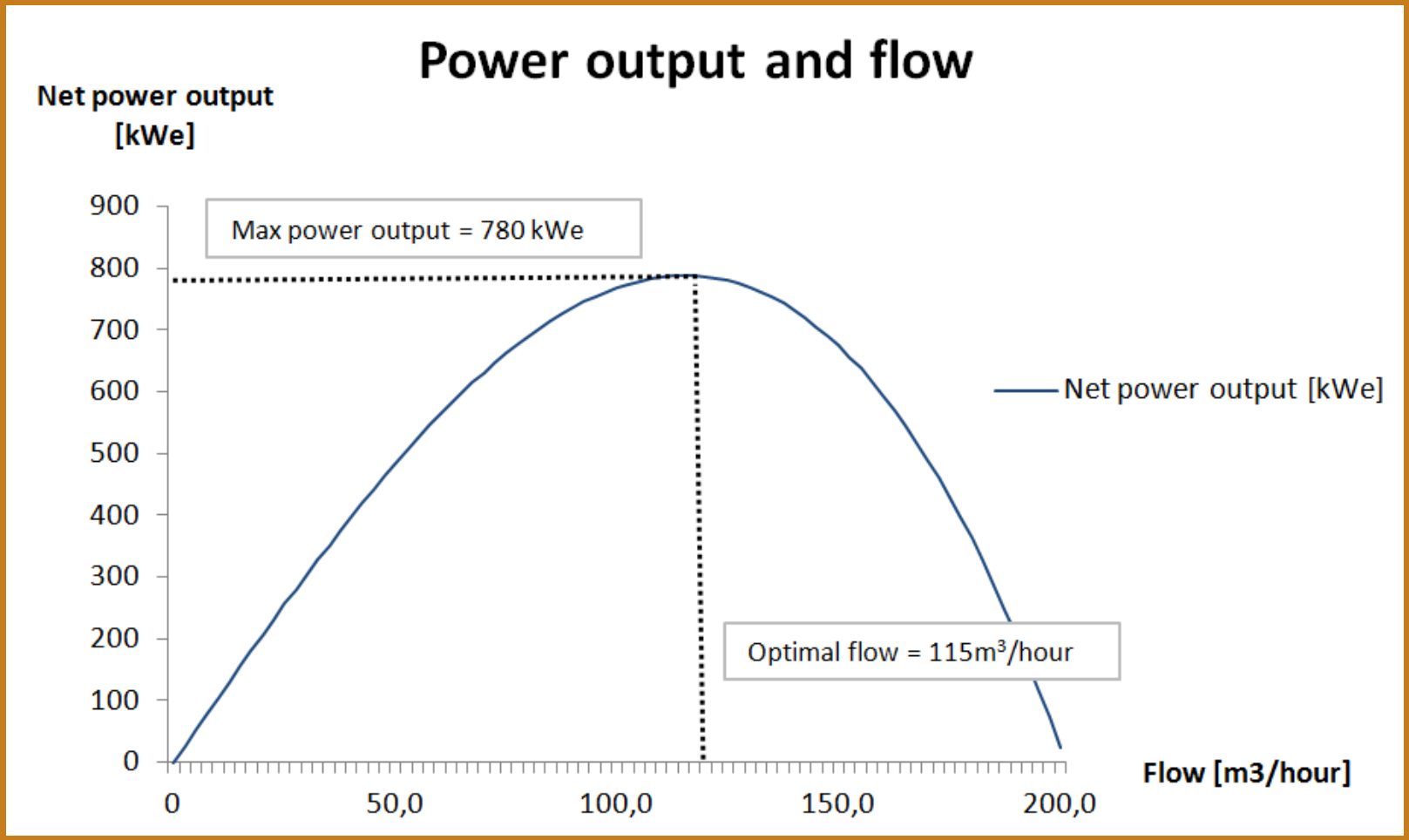
But can this compete with Diesel and PV?

Lets take an example case

Example case: Input parameters

Production temperature	150 °C
Drilling depth	2300m TVD
Casing I. diameter	4 Inch
Reservoir transmissivity	25 Dm

Calculating the optimal flow



Example case: LCOE

CAPEX	$7,400,000
OPEX	$190,000 /year
Yearly production	4700 MWh
LCOE (30y / 7% disc)	**$0.15 /kWh**

Example case: Comparing to diesel and PV

Generation type	LCOE
Off-grid Diesel (1$/l)[1]	$0.56/kWh
PV individual[2]	$0.70/kWh
PV-Diesel Hybrid[2]	$0.35/kWh
PV-Battery (saba case)[3]	$0.31/kWh
MiniGeo	**$0.15/kWh**

Discussion points

- 6000 full load hours per year realistic?
- Technical challenges of high pressure and high flow
- How to organise secundary outputs?
- Risk management

Sources

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2 PLN statistics 2009
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4 Velthuis, MODELING AND SIMULATIONOF PHOTOVOLTAIC SYSTEMS IN INDONESIA, 2015
5 Hirsch, K., Burman, C., & Davidson, M. (2015). Sustainable energy in remote indonesian grids. *National renewable energy l laboratory,* June 2015