III GGDP Roundtable; April 25 - 26, 2016

Harpa Conference Center –Reykjavik, Iceland

First Results of GeoCap Studies of the Potential of Geothermal Direct Use in Western Java and of Low Enthalpy Geothermal Electricity to Replace Diesel Fired Generators

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Ministry of Foreign Affairs of the Netherlands

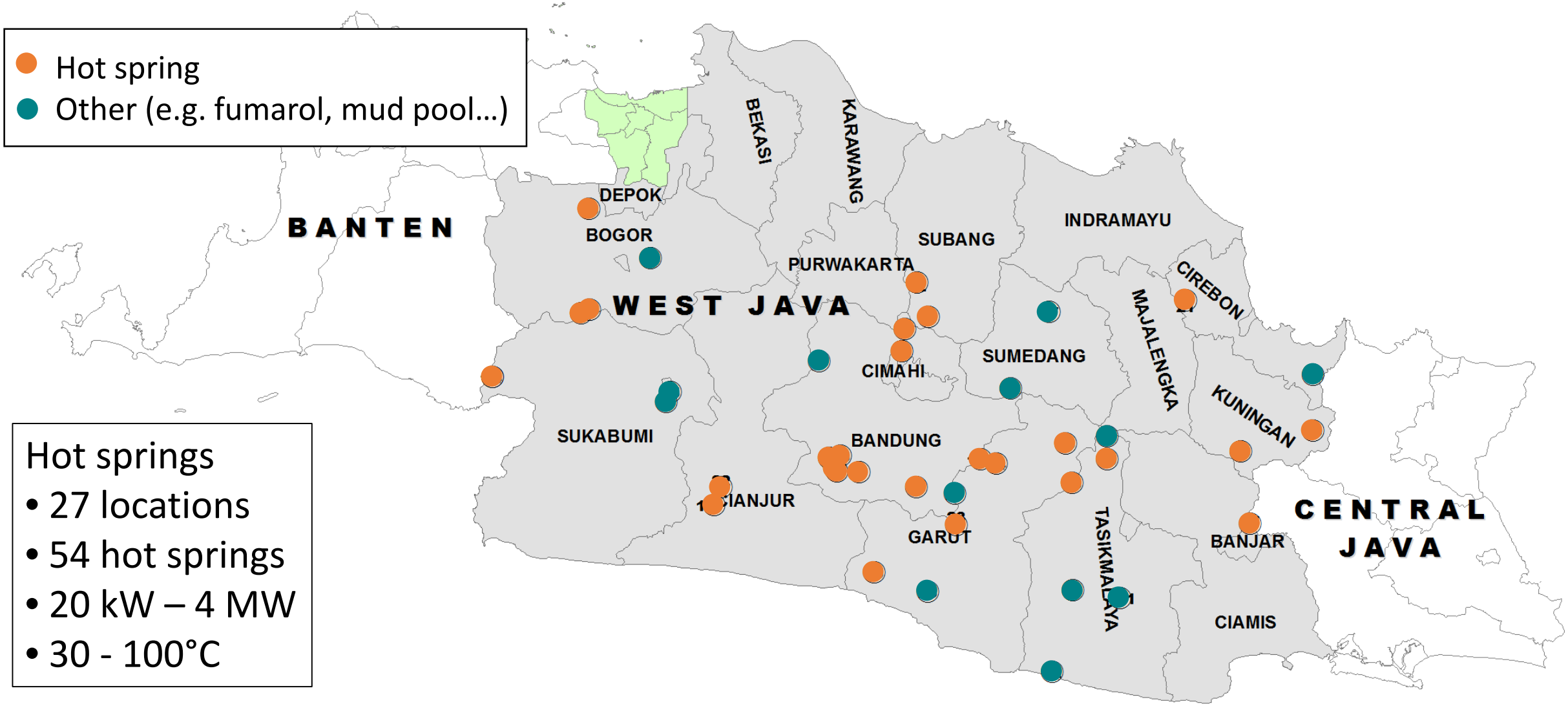
Low – medium enthalpy geothermal resources

- Temperature: < 200°C
- Resources:
  - Surface manifestations
  - Geothermal waste heat
  - Sedimentary basins
  - Volcanic reservoirs
- Main demand direct use: process heat industry (30% of total energy end use Indonesia in industry)

Direct use - existing

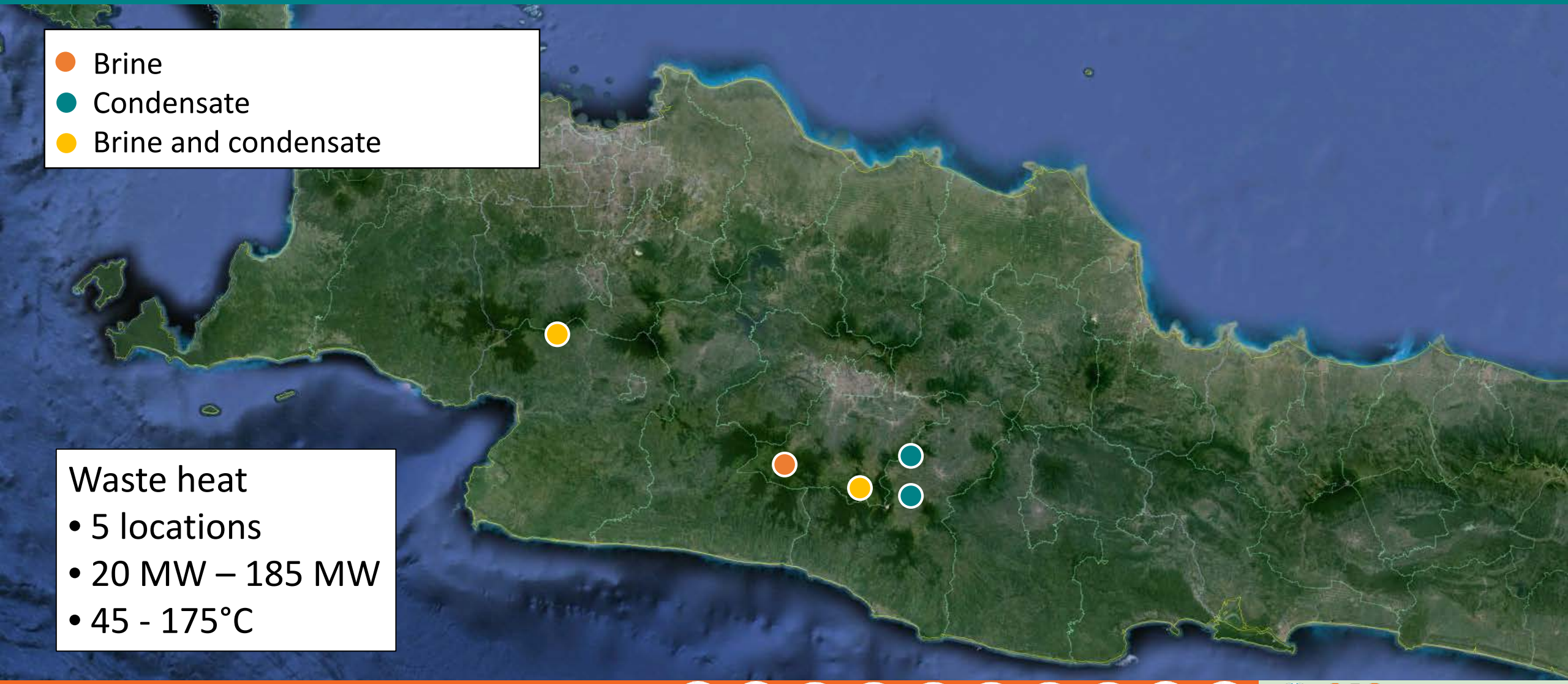
Market	Temperature	Type	Location
Catfish farming	40°C	Commercial	Lampung
Warm bathing	43-45°C	Commercial	West/Central/East Java, Bengkulu
Mushroom & potato cultivation	60-65°C	Pilot	Pangalengan
Mushroom cultivation	60-65°C	Pilot	Kamojang
Cacao & coconut drying	60-80°C	Pilot	Way Ratai
Tea drying	98-120°C	Pilot	Pangalengan
Palm sugar processing	107-110°C	Commerical	Lahendong

Surface manifestations



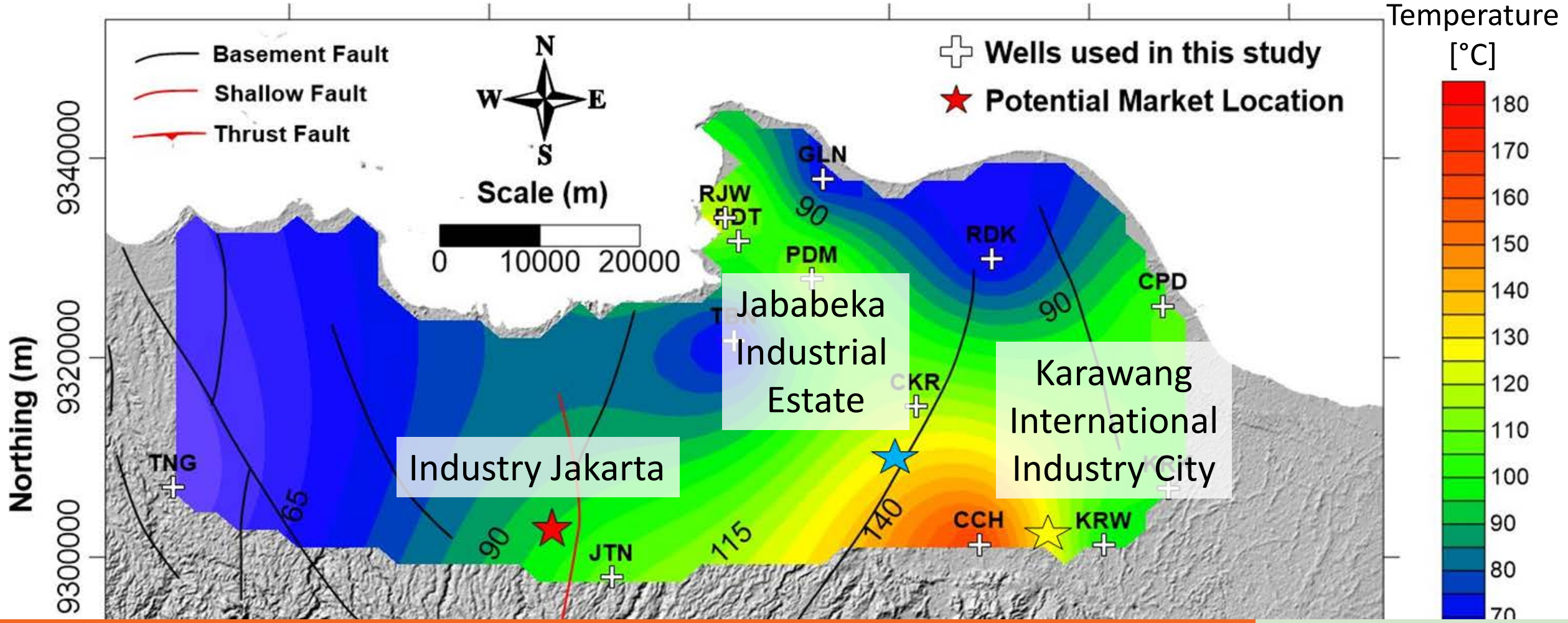
Hot springs
- 27 locations
- 54 hot springs
- 20 kW – 4 MW
- 30 - 100°C

Waste heat power plants



Waste heat
- 5 locations
- 20 MW – 185 MW
- 45 - 175°C

Oppertunities in Java basin



Next steps

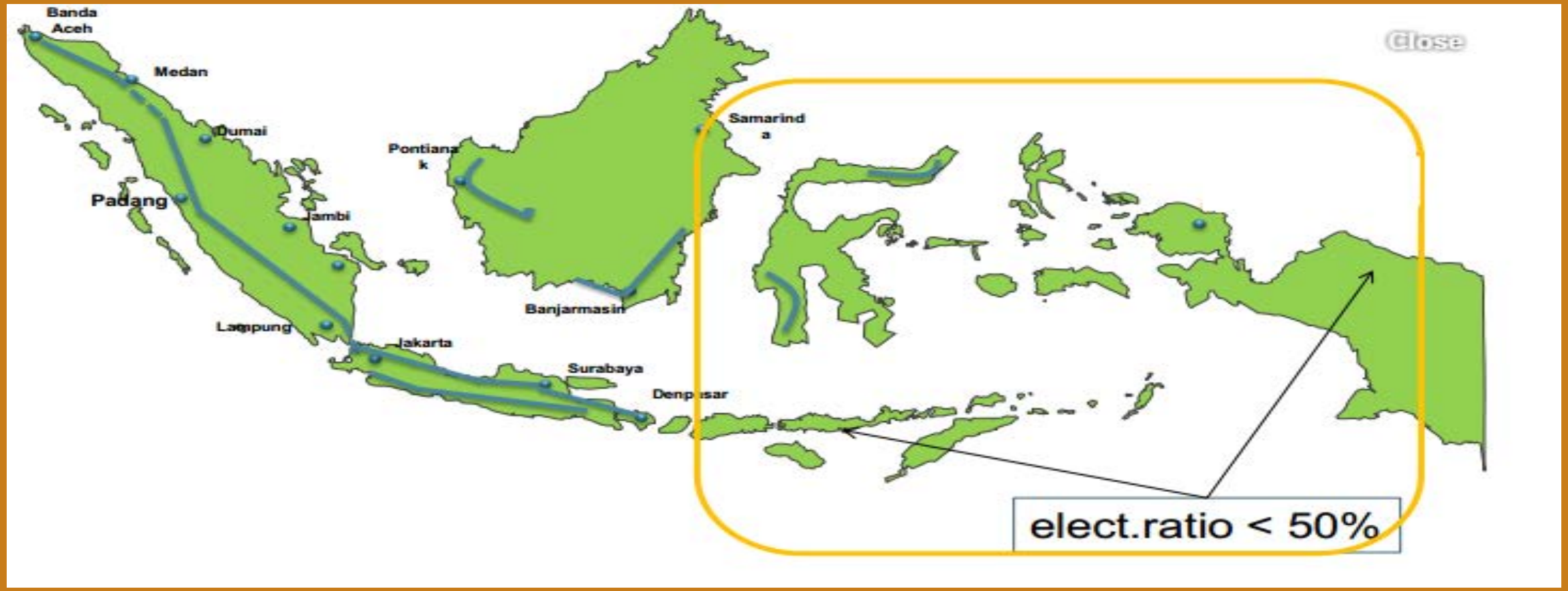
- Identify matches
- Perform quick scans feasibility: depends strongly on
  - Reservoir properties
  - Reference case (what is used now for heating?)
  - Size of demand
  - Temperature of demand
- Move towards pilot/demo projects

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

if

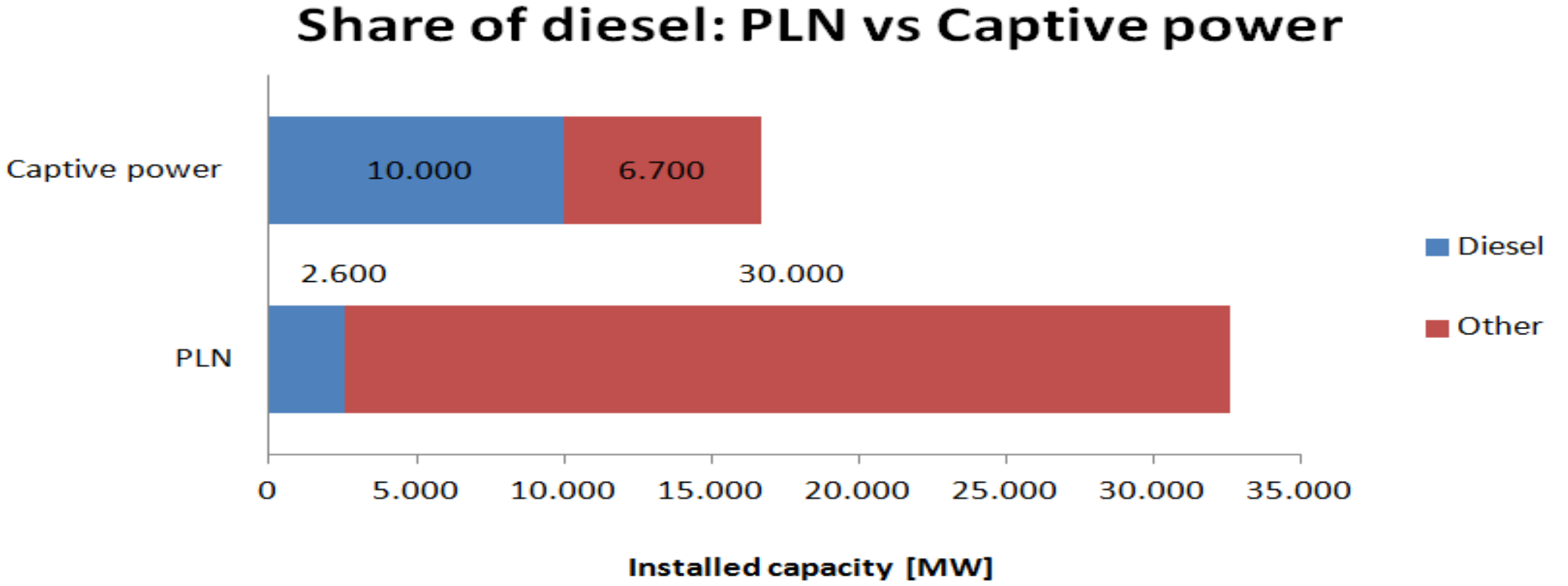
GEOCAP

Indonesia is a very large country with many small and remote islands



This leaves many relying on dirty and expensive diesel generators

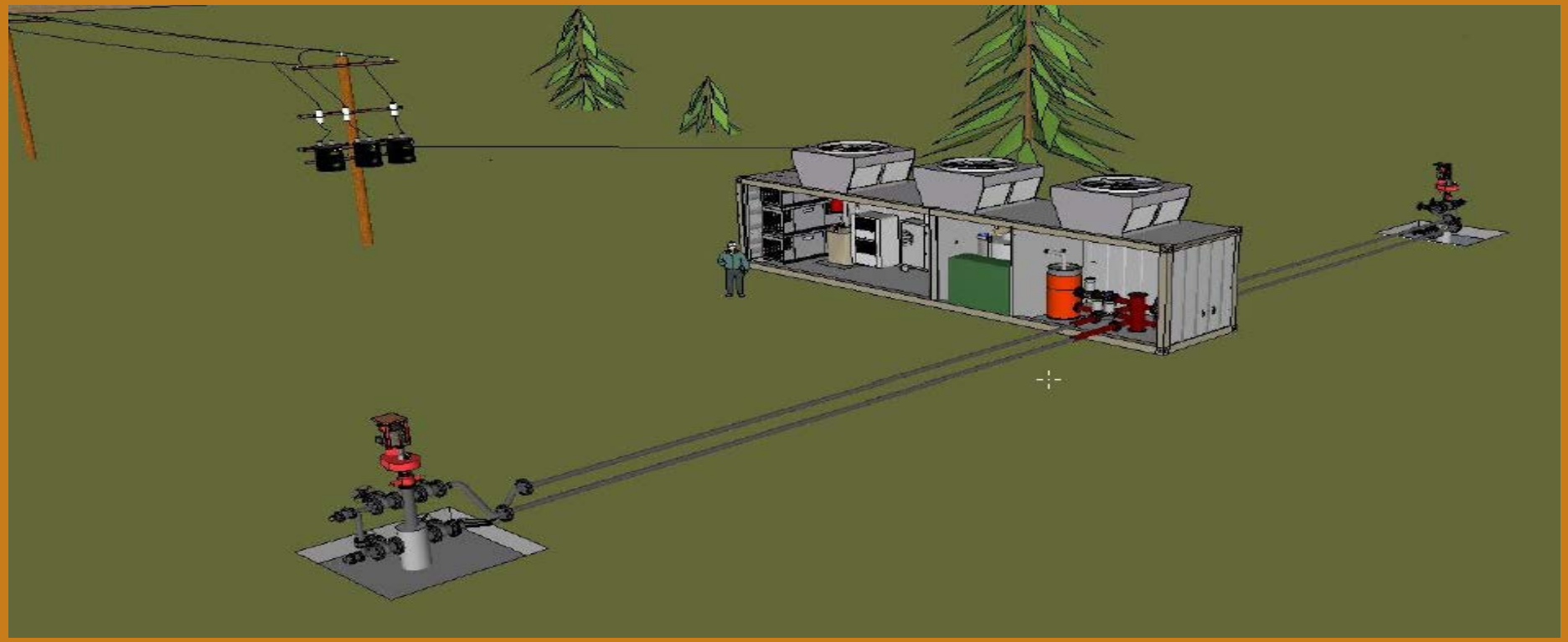
With a significant share in the total power production



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
- Near-zero marginal costs & no emissions
- Secondary outputs

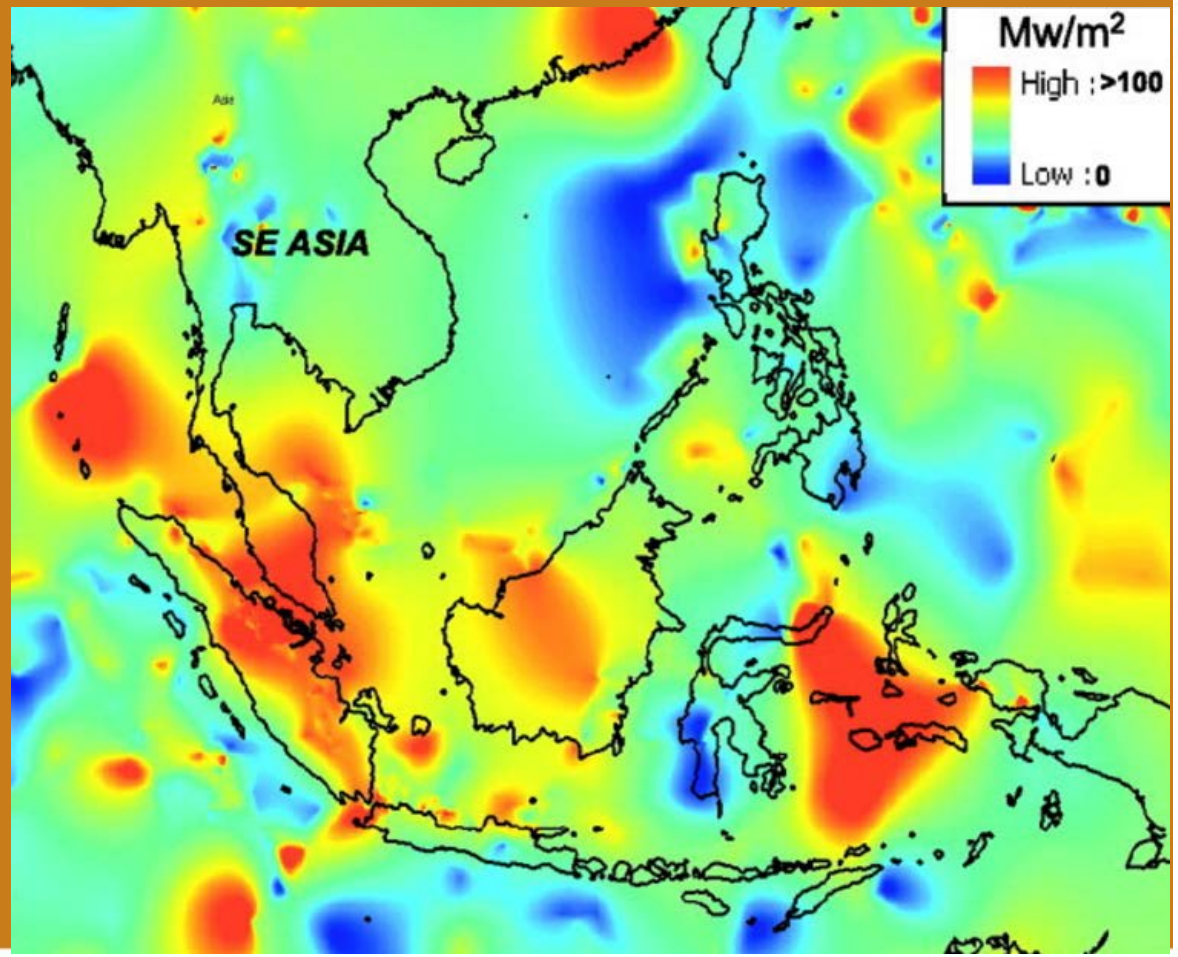
Secondary output modules

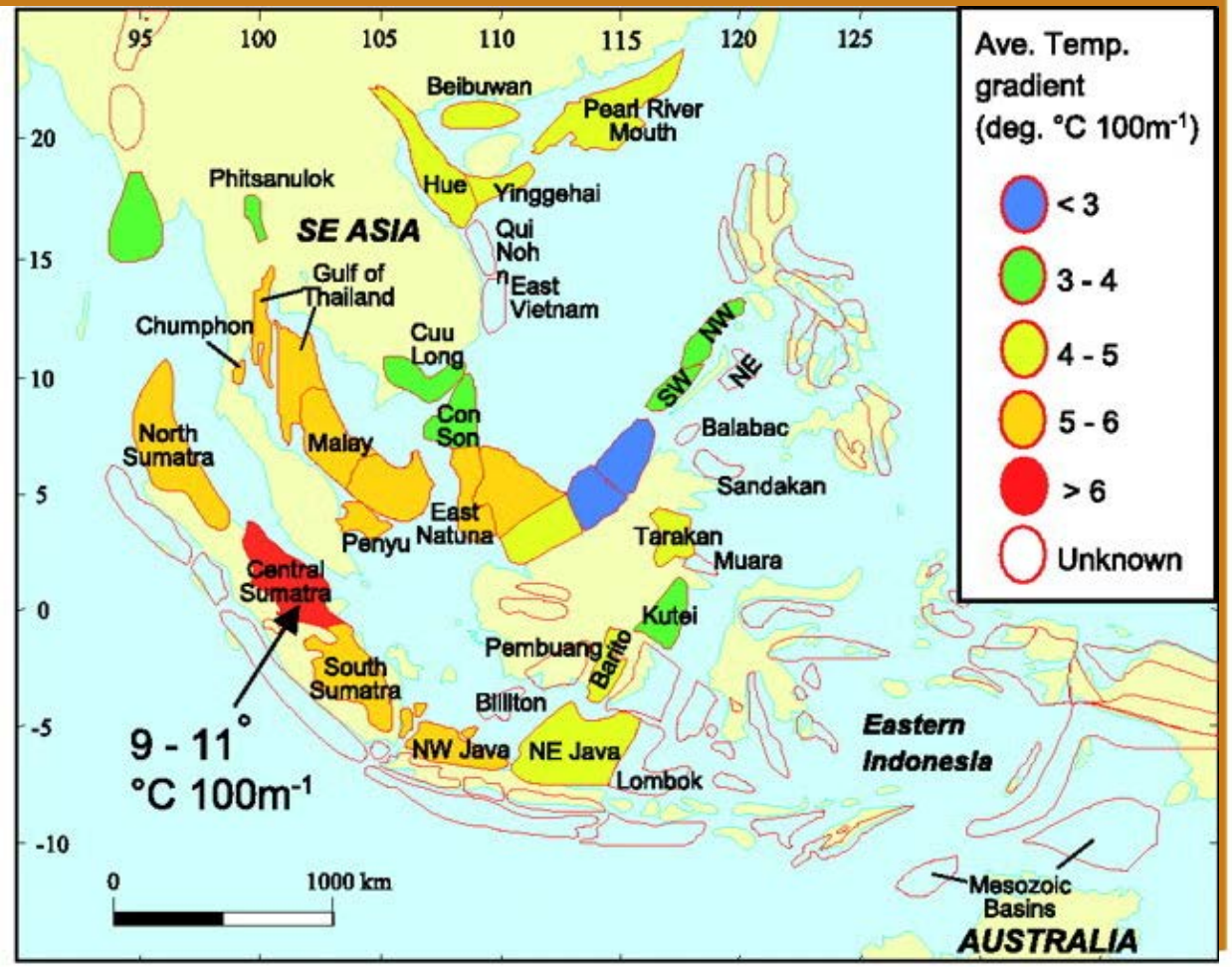
- Drinking water (desalination or aquifer based)
- Cooling / Ice production
- Communication (Internet, mobile network, 3G/4G, Radio, Television)
- Crop drying/processing
- Waste(water) treatment
- Bathing, laundry, hotspring

But can this compete with Diesel and PV?

Lets take an example case

Heat flow and thermal gradient in sedimentary basins in Indonesia

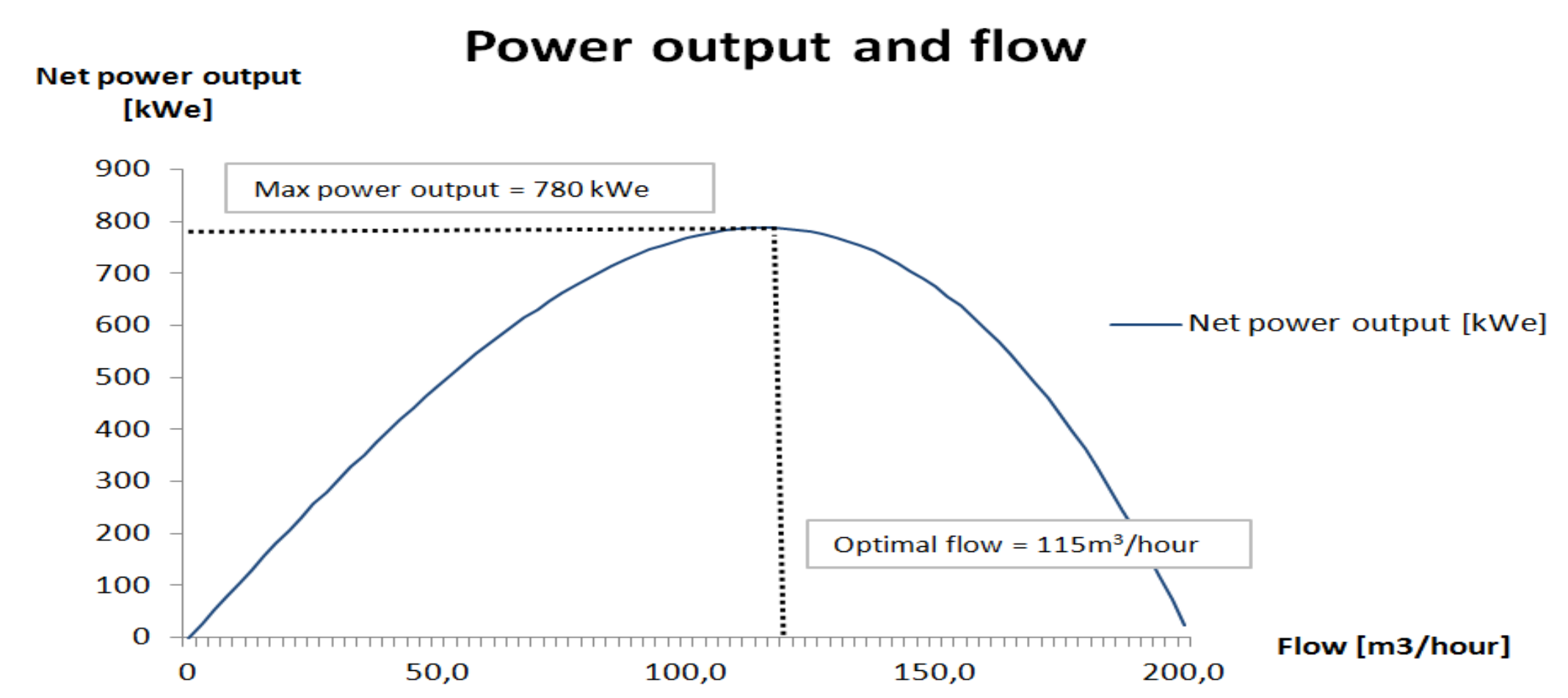




Example case: Input parameters

Production temperature	150 °C
Drilling depth (55 C/km gradient)	2300m TVD
Casing diameter	4 “
Reservoir transmissivity	25 Dm

Calculating the optimal flow



Example case: LCOE

CAPEX for survey, two small holes + ORC + cooling + grid connection	$7,500,000	
OPEX	$200,000	/year
Yearly production	5000	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**

Geothermal feed in tariff

GEOTHERMAL (PLTP) FEED-IN-TARIFF[1]

PERIOD	REGIONS			REFERENCE
	Area 1	Area 2	Area 3	
2015	11.80	17.00	25.40	PerMenESDM No. 17 of 2014
2016	12.20	17.60	25.80	
2017	12.60	18.20	26.20	
2018	13.00	18.80	26.60	
2019	13.40	19.40	27.00	
2020	13.80	20.00	27.40	
2021	14.20	20.60	27.80	
2022	14.60	21.30	28.30	
2023	15.00	21.90	28.70	
2024	15.50	22.60	29.20	
2025	15.90	23.30	29.60	

1. In USD cent per kWh.

Next steps

- Organize demo project(s) in Indonesia
- Also look for projects in other regions where this may apply like Philippines, East Africa, etc.

THANK YOU!