BADAN PENGKAJIAN DAN PENERAPAN TEKNOLOGI
(BPPT)

INNOVATION OF SMALL SCALE GEOTHERMAL POWER TECHNOLOGY IN BPPT

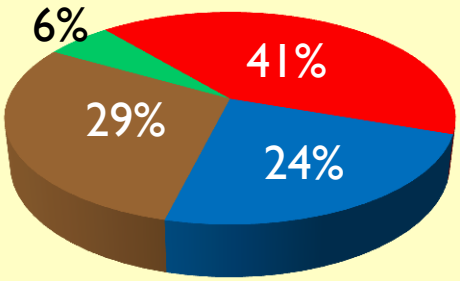
WORKSHOP ON
USE OF LOW-MEDIUM ENTHALPY GEOTHERMAL RESOURCES
Bandung, 7 April 2016

TEKNOLOGI ENERGI UNTUK KELISTRIKAN

TARGET OF ENERGY MIX BY 2025

(Ref. PP 79 / 2014)

2012

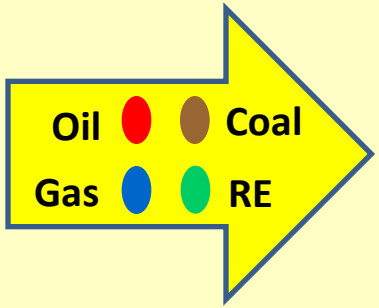


Power Plant : 44.1 GW

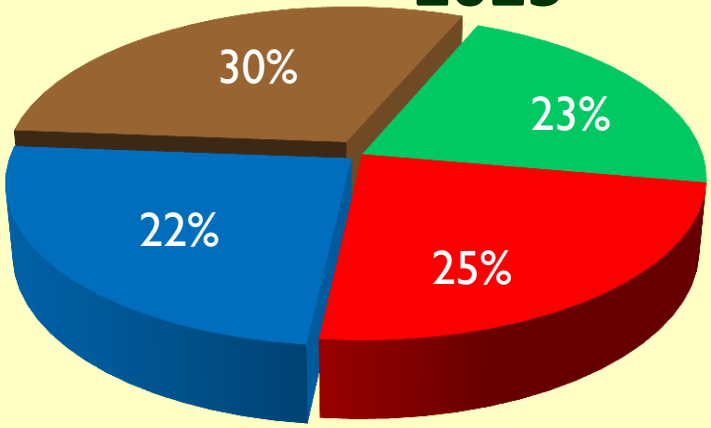
Electricity Consumption : 707 kWh/Capita

Total Energy: 185 MTOE

Energy Consumption : 0.8 TOE/Capita



2025



Power Plant : 115 GW

Electricity Cons. : 2500 kWh/Capita

Total Energy: 400 MTOE

Energy Cons. : 1.4 TOE/Capita

Geothermal PP

Source : EBTKE

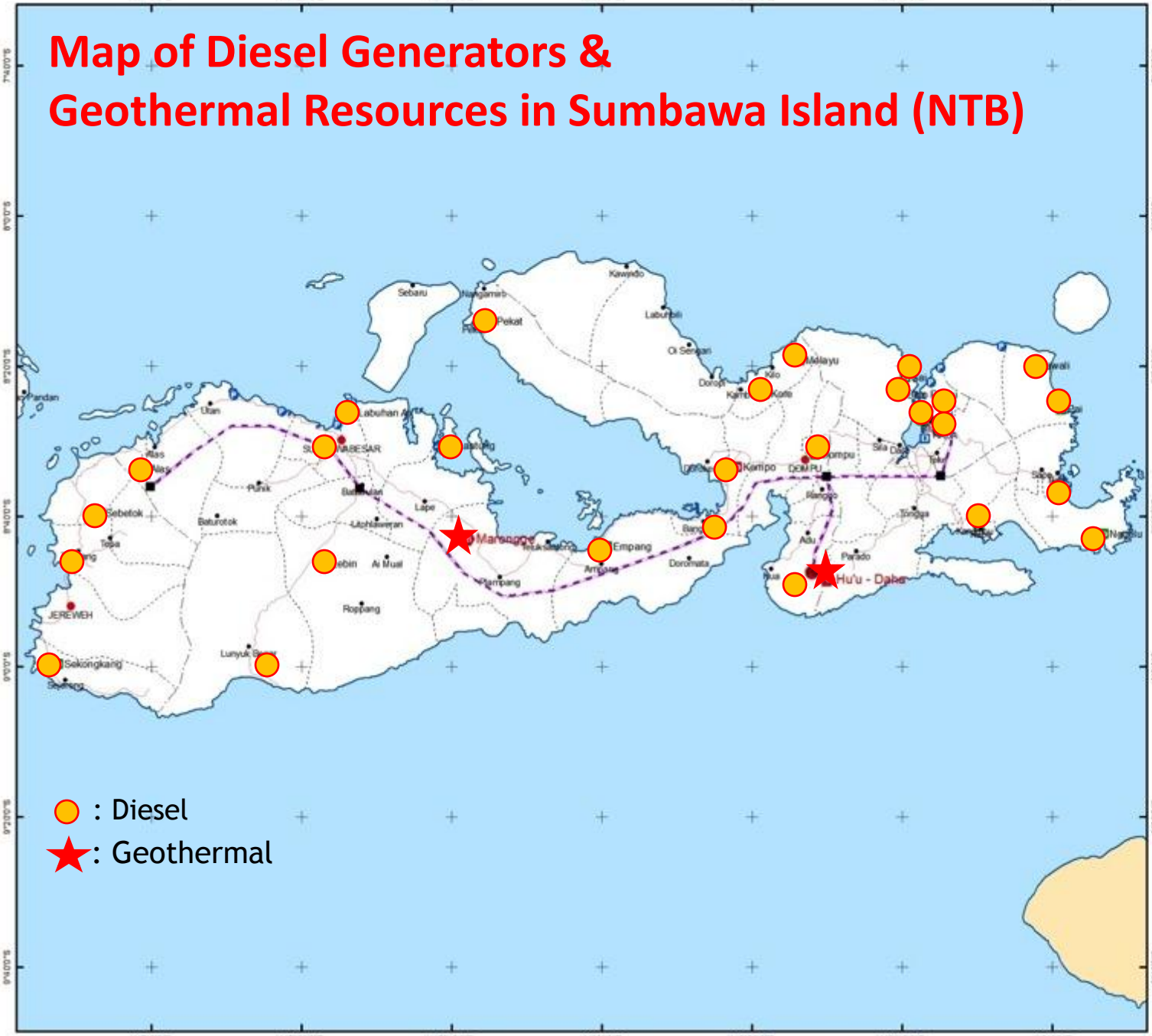
INST. CAP.	2014	2015	2016	2917	2018	2019	2020	2021	2022	2023	2024	2025
	60	37	279	293,5	808,5	960	495	354	1.084	640	175	565
1.438,5	-	**1.438,5**	1.717,5	2.011	2.819,5	3.779,5	4.274,5	4.628,5	5.712,5	6.352,5	6.527,5	**7.092,5**

URGENCY & TARGET

1. To develop geothermal power generation technology (condensing turbine and binary cycle technology) by local human resources, involving Indonesian local industries.
   → To increase the local content (TKDN), in order to realize the nation independence on the electricity industries.
   → The Government's plan is to build 7000 MW geothermal by 2025. How much is the local content?

2. To substitute the use of diesel oil power plants.
   → In 4 provinces in the eastern parts of Indonesia, there are more than 195 MW diesel generators which can be replaced by small scale geothermal plants. It will save the use of diesel oils for more than Rp. 1 Trillions annually.
   → PT. PLN has been starting constructing 3 – 5 MW geothermal power plants in Flores.

Map of Diesel Generators & Geothermal Resources in Sumbawa Island (NTB)



N

Skala 1 :520000

Proyeksi : Geographic Coordinate Systems
Sistem Grid : WGS84
Sumber : - Peta Rupa Bumi Bakosurtanal 1:50.000
- Direktorat Inventarisasi Sumberdaya Mineral
- PT. PLN Wilayah Nusa Tenggara Barat

Keterangan

- Kota Kabupaten
- Kota Kecamatan
- Lokasi Sumur Panas Bumi
- Rencana Gardu Induk
- Garis Pantai
- Batas Kabupaten
- Batas Kecamatan
- Jalan raya

Jaringan Listrik

- Rencana Jaringan 70 kV

PLTD Exsisting

- Non Isolated
- Isolated

Rencana Pembangkit Listrik

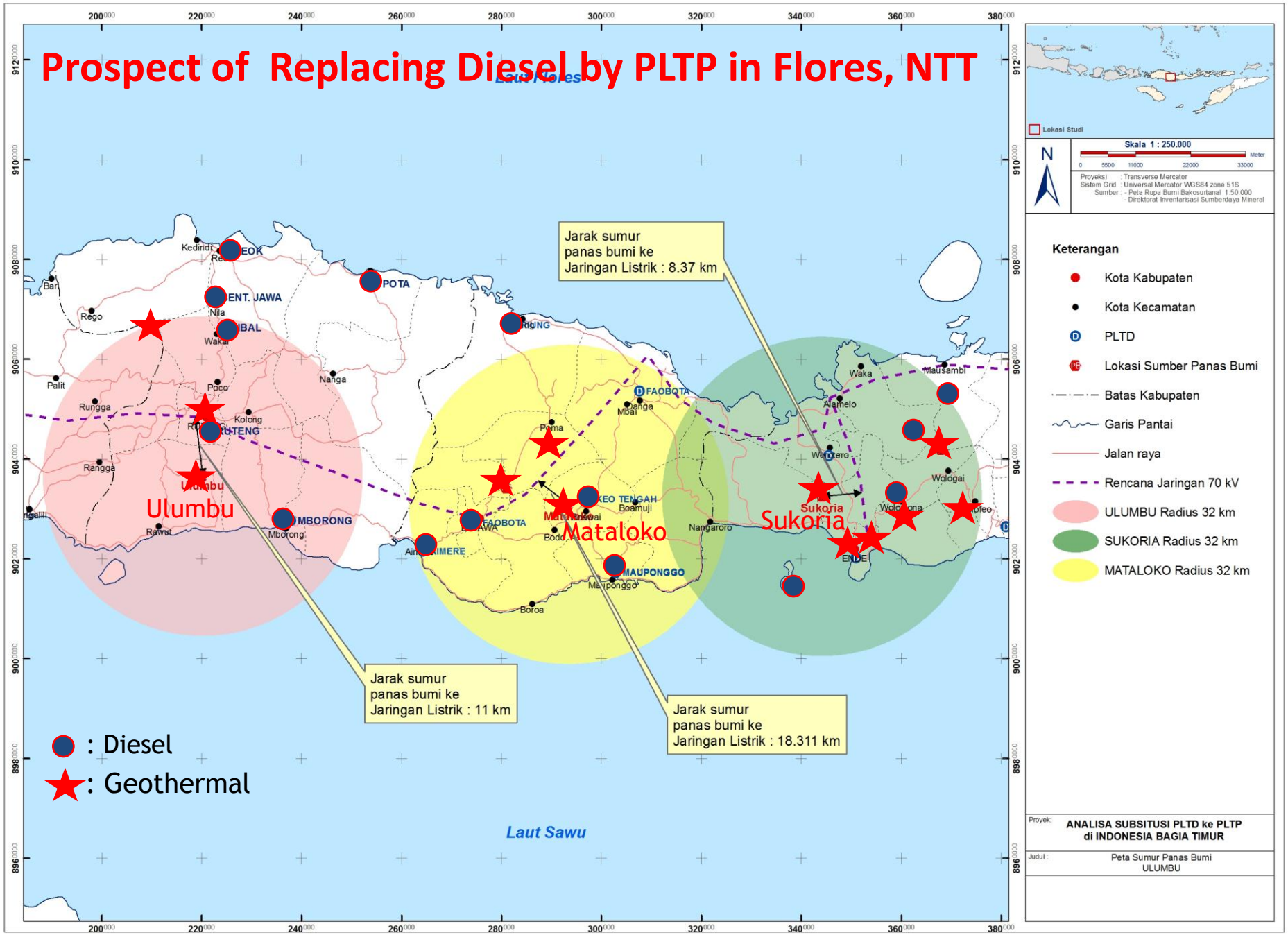
- PLTU
- PLTP
- PLTD

Proyek: **ANALISA SUBSITUSI PLTD ke PLTP di INDONESIA BAGIAN TIMUR**

Judul: Peta Sumur Panas Bumi Pulau Sumbawa

RISTEK

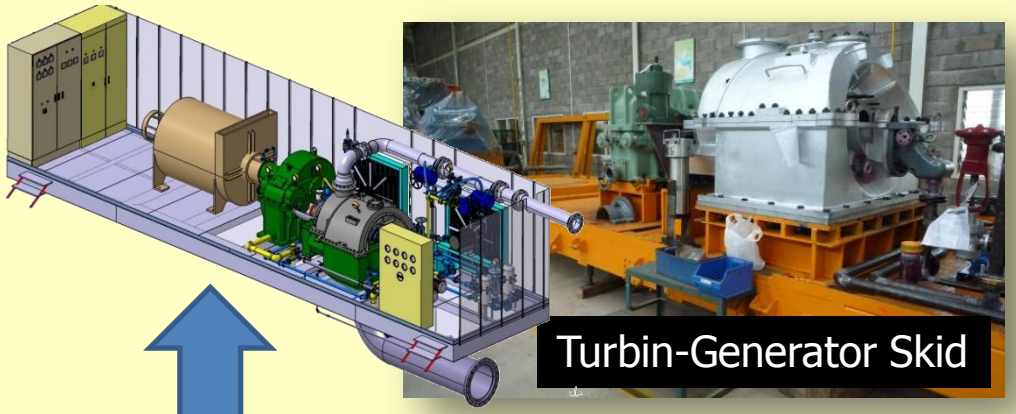
Prospect of Replacing Diesel by PLTP in Flores, NTT



URGENCY & TARGET

3. To develop a geothermal power generation as a pioneer/utility in developing geothermal fields (during the construction period).
   → There are new geothermal fields as the potential markets.

Diesel for Drilling



4. The utilization of small production wells (declined wells) to generate electricity.
   → PT. PGE starts thinking of constructing small scale 5 MW power plants by utilizing small production wells.

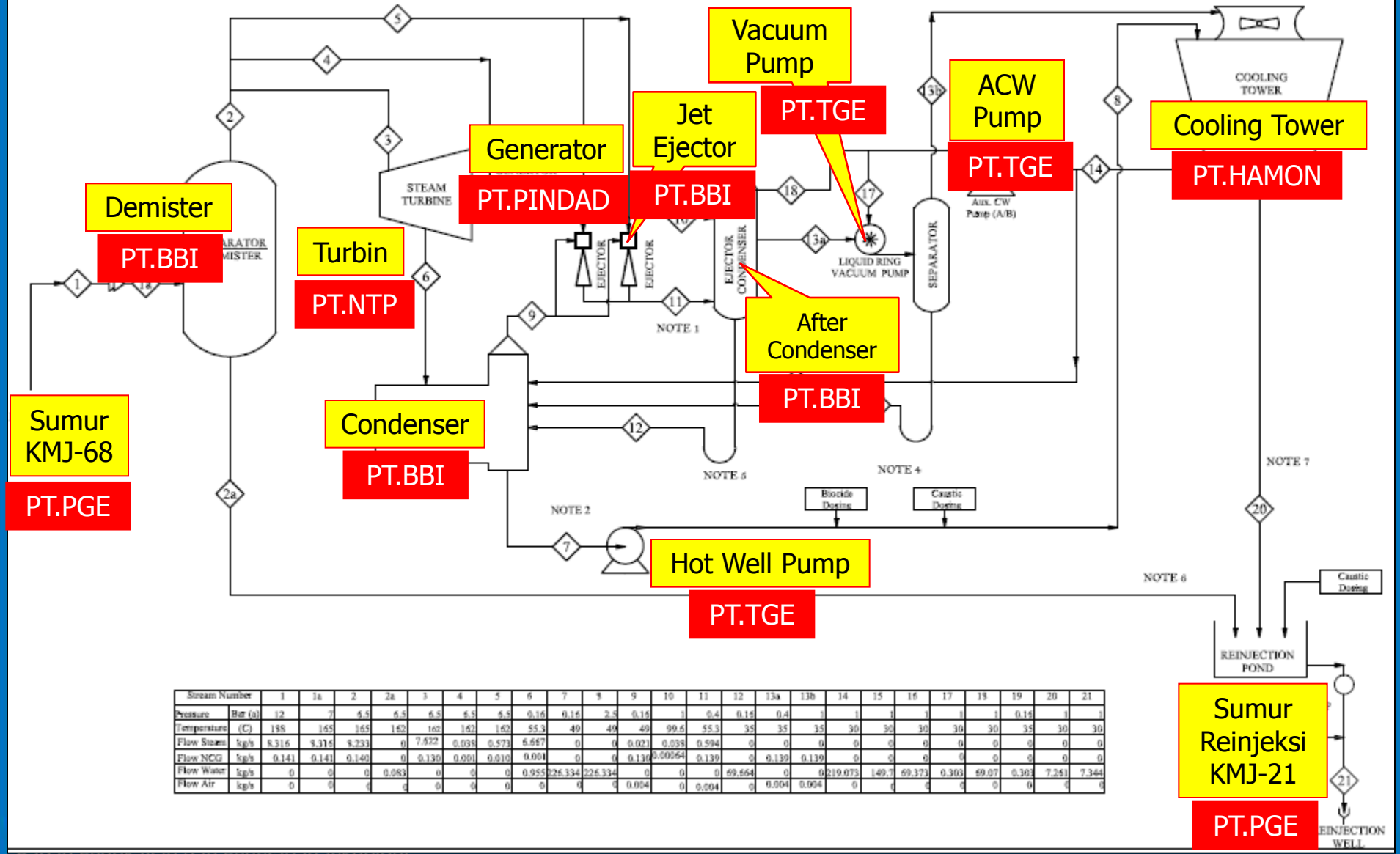
PLTP CONDENSING TURBINE 3 MW KAMOJANG

Cooperation between

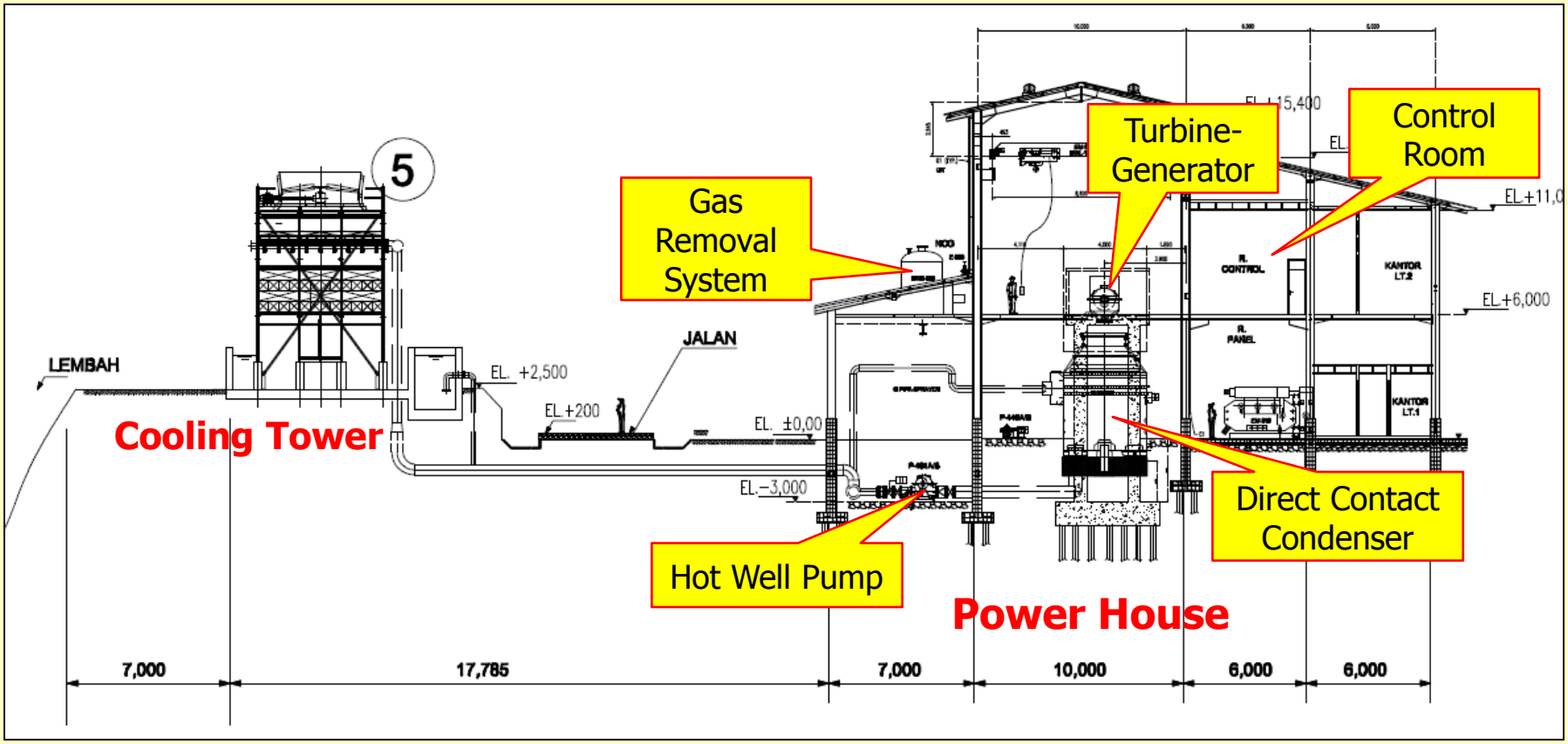
BPPT – PT. PGE – Ministry of Forestry – PT. PLN

- Ministry of Forestry to provide location in the Cluster KMJ-48.
- PT. PGE to provide steam from the KMJ-68 well.
- BPPT to prepare the engineering design and build the pilot plant.
- PT. PLN to provide technical assistance in connecting to the 20 kV transmission line.

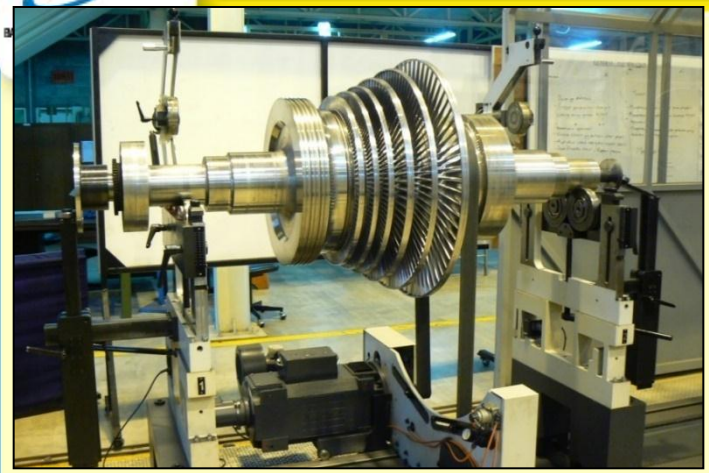
PROCESS FLOW DIAGRAM



Stream Number		1	1a	2	2a	3	4	5	6	7	8	9	10	11	12	13a	13b	14	15	16	17	18	19	20	21
Pressure	Bar (a)	12	7	5.5	6.5	6.5	5.5	5.5	0.16	0.16	2.5	0.15	1	0.4	0.15	0.4	1	1	1	1	1	1	0.15	1	1
Temperature	(C)	188	165	165	162	162	162	162	55.3	49	49	49	99.6	55.3	35	35	35	30	30	30	30	30	35	30	30
Flow Steam	kg/s	8.316	8.316	8.233	0	7.822	0.038	0.573	6.667	0	0	0.021	0.038	0.594	0	0	0	0	0	0	0	0	0	0	0
Flow NCG	kg/s	0.141	0.141	0.140	0	0.130	0.001	0.010	0.001	0	0	0.130	0.00064	0.139	0	0.139	0.139	0	0	0	0	0	0	0	0
Flow Water	kg/s	0	0	0	0.083	0	0	0	0.955	226.334	226.334	0	0	0	69.664	0	0	219.073	149.7	69.373	0.303	69.07	0.303	7.261	7.344
Flow Air	kg/s	0	0	0	0	0	0	0	0	0	0	0.004	0	0.004	0	0.004	0.004	0	0	0	0	0	0	0	0


5
Cooling Tower
LEMBAH
JALAN
EL. +2,500
EL.+200
EL. ±0,00
EL.-3,000
Gas Removal System
Turbine-Generator
Control Room
Hot Well Pump
Direct Contact Condenser
Power House
EL.+15,400
EL.+11,0
EL.+6,000
R. CONTROL
R. PANEL
KANTOR LT.2
KANTOR LT.1
7,000
17,785
7,000
10,000
6,000
6,000

EQUIPMENT MANUFACTURE



CONSTRUCTION

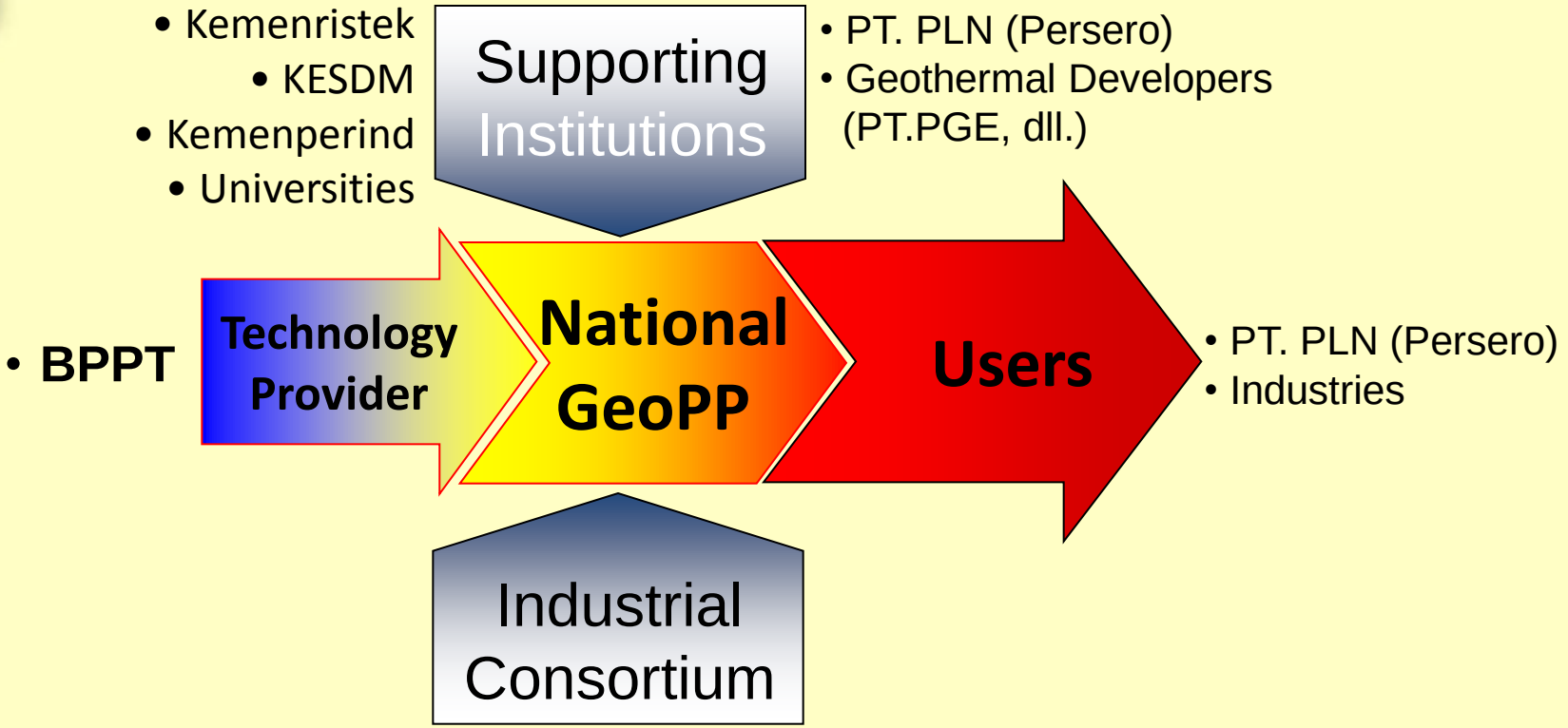



TESTING





COOPERATION SCHEME

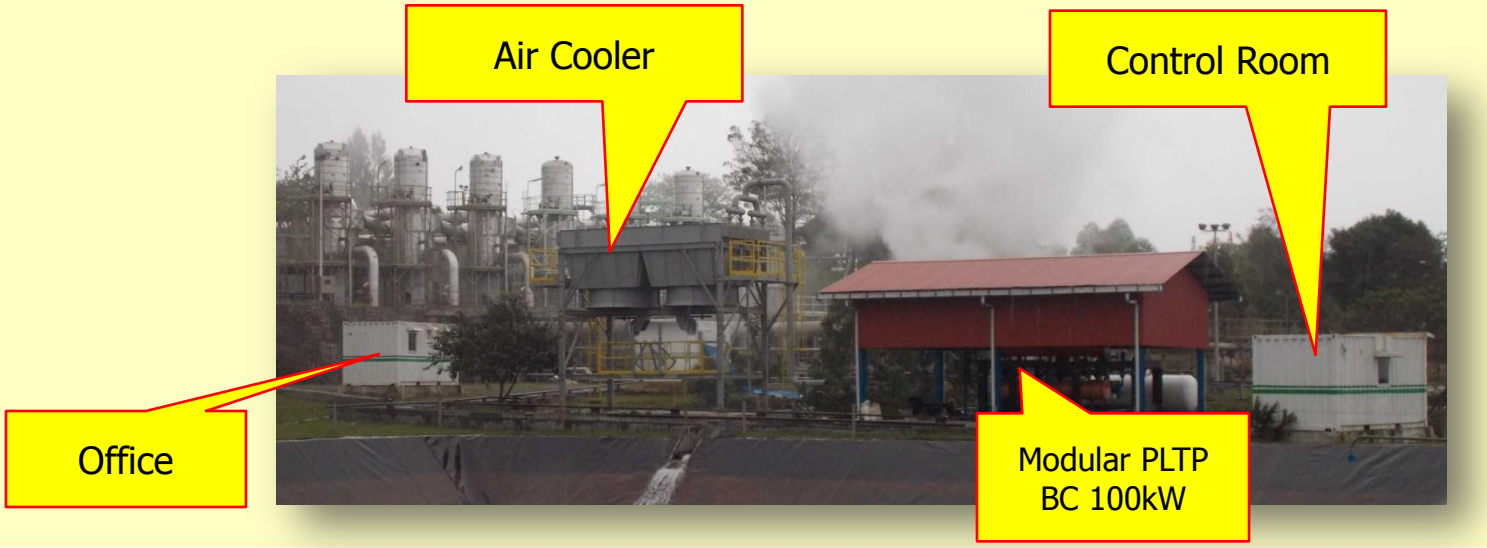


PLTP BINARY CYCLE 100 KW

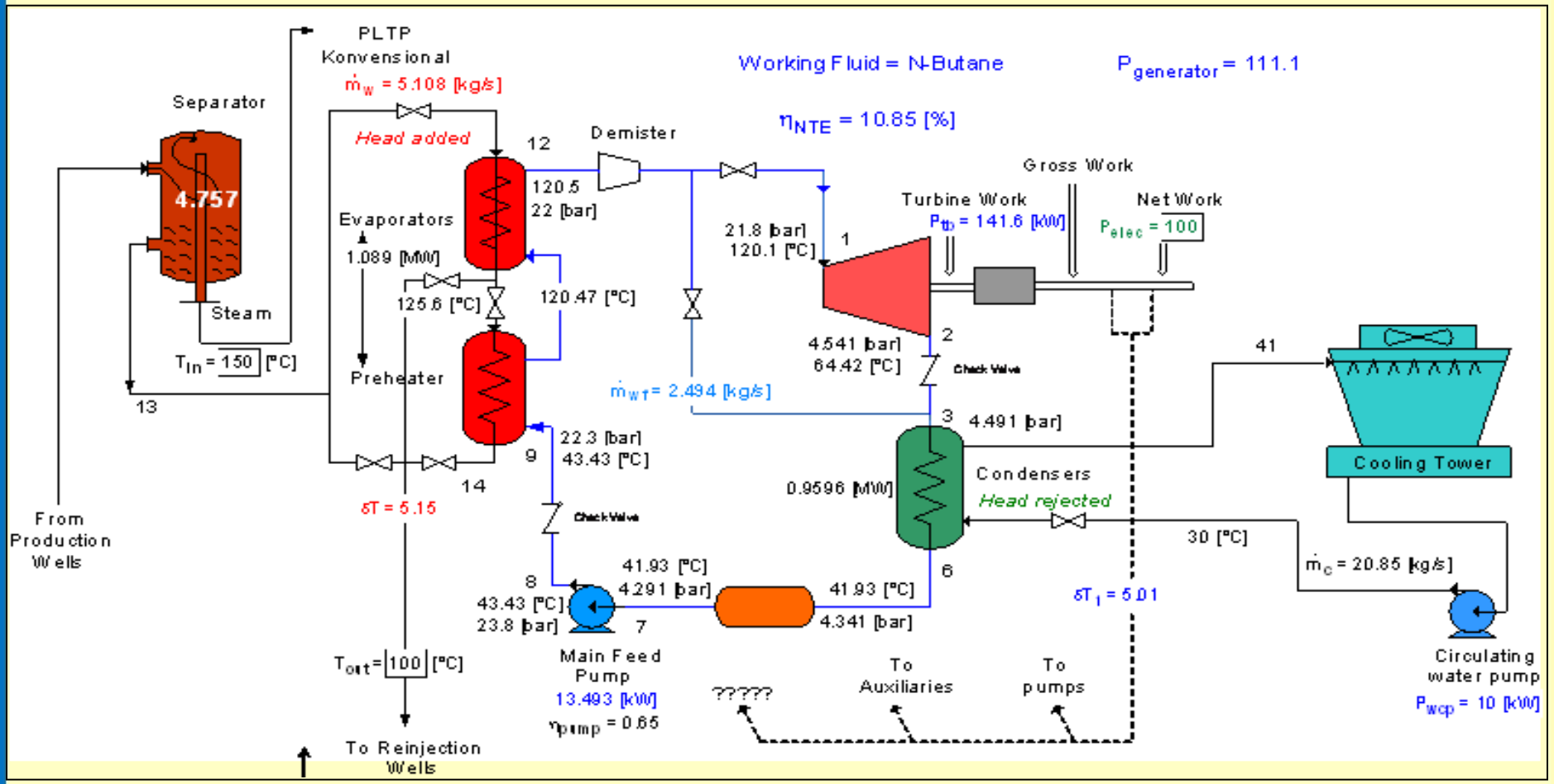
Cooperation between

BPPT and STAR ENERGY (WW) GEOTHERMAL LTD.

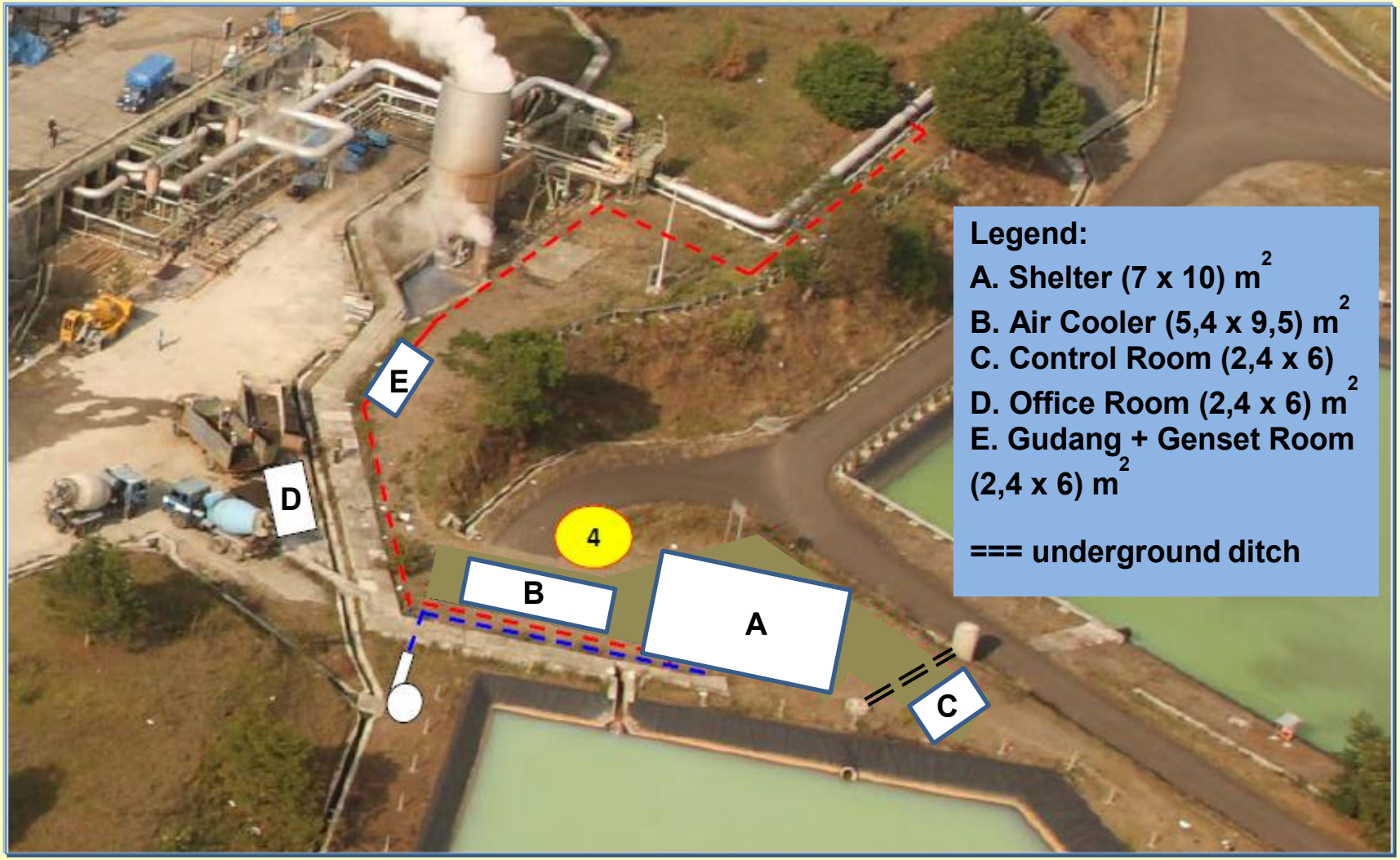
- SE(WW)GL to provide location and brine from the separator
- BPPT to prepare the engineering design and build the pilot plant



HEAT & MASS BALANCE CALCULATION



GENERAL LAYOUT



100 KW GEOTHERMAL BINARY CYCLE

Main Equipments

PREHEATER

EVAPORATOR

CONDENSER

100 KW GEOTHERMAL BINARY CYCLE





DEMO PLANT
PLTP BINARY CYCLE 500 KW

Indonesia – Germany Bilateral Cooperation

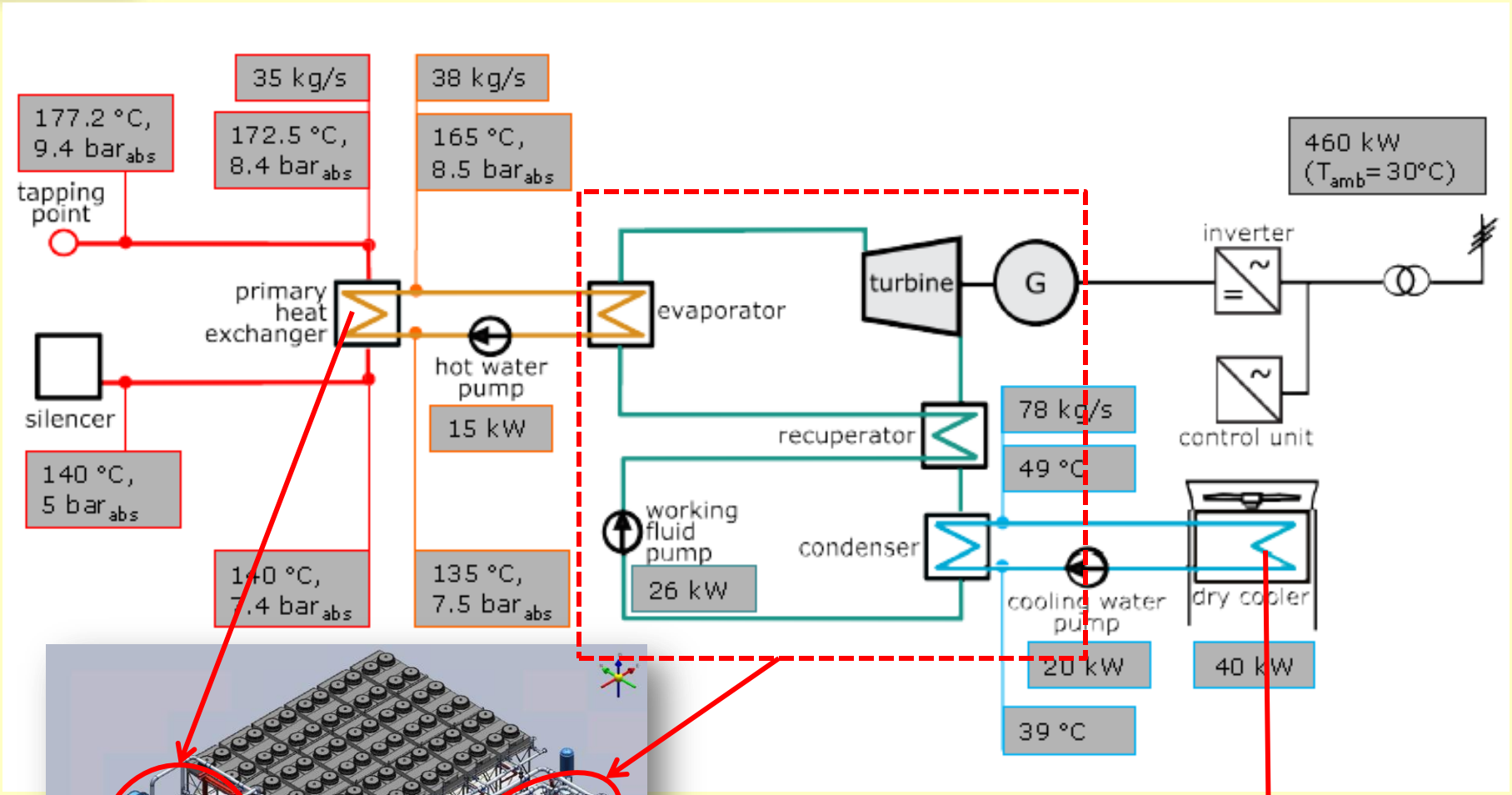
RISTEK - BMBF

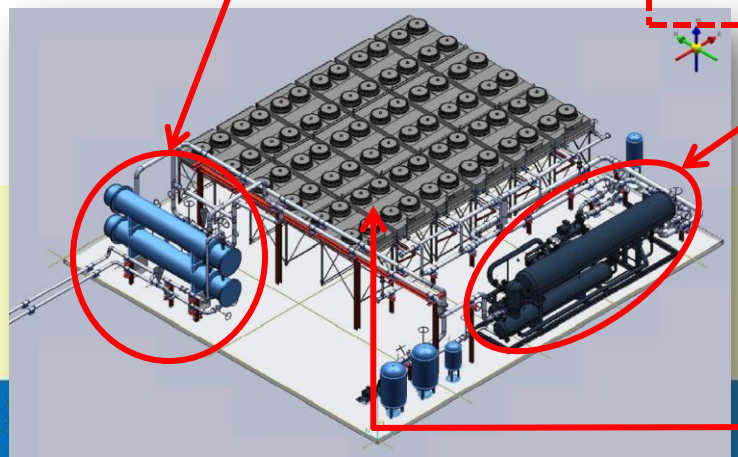
Implementing Agreement :

BPPT – PT. PGE – GFZ (Jerman)

- PT. PGE to provide brine from the separator.
- BPPT to provide location.
- GFZ to provide modular ORC/binary cycle.
- System design is prepared together by all parties.

SCHEME DIAGRAM



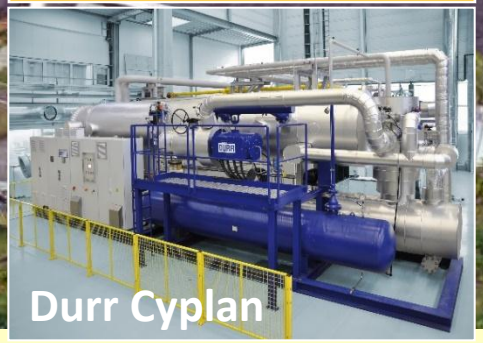


500 KW GEOTHERMAL BINARY CYCLE POWER PLANT AT LAHENDONG

Primary Heat Exchanger

Dry cooler

ORC Unit



Electricity :
As a power source for PT.PGE's reinjection pump.
The excess power going into PT. PLN grid.

ADVANTAGES OF SMALL SCALE GEOPP

1. It can be applied as a pioneer/utility plant during the development stage of a geothermal field or construction period of the large plant.

   → To save the use of diesel oils, or to get revenue before the large scale start in operation.

2. It can be relocated when the large scale start in operation.

   → Flexible and practical.

3. It can be applied to utilize the separated hot brine to generate an additional electricity without drilling a new well.

   → Increase the revenue from the additional power generation.

4. According to the Ministry ESDM regulation, the electricity from small scale geothermal power plant (and also the other renewable energy sources) must be purchased/accepted by PT. PLN.

   → Business certainty.

RECCOMENDATION

Strategy to build nation independence in the electricity industries :

a) To develop **local technology** by establishing **a manufacturer industrial consortium** for **national geopp**.

b) The big support by the government, banking industries and PT PLN in developing small scale geopp by providing an opportunity for the local industries in proving their capabilities (quality and realibility to follow).

c) The first stage: ***economic benefit*** must be prioritized than *financial benefit*.

TERIMA KASIH

BADAN PENGKAJIAN DAN PENERAPAN TEKNOLOGI
(BPPT)

TEKNOLOGI ENERGI UNTUK KELISTRIKAN

Geothermal Research Group
BPPT