

Klaster Energi Surya - ITB



Institut Teknologi Bandung

**Lokakarya Energi Baru Terbarukan dan Konservasi Energi
21 Januari 2011**



Outline



-
- **Pendahuluan**
 - Potensi Surya Indonesia
 - Divais Konversi Energi Surya
 - PV Production
 - **Road Map Penelitian Indonesia**
 - **Kluster Energi Surya ITB**
 - Kontributor
 - Ringkasan

Kluster Energi Surya - Kontributor

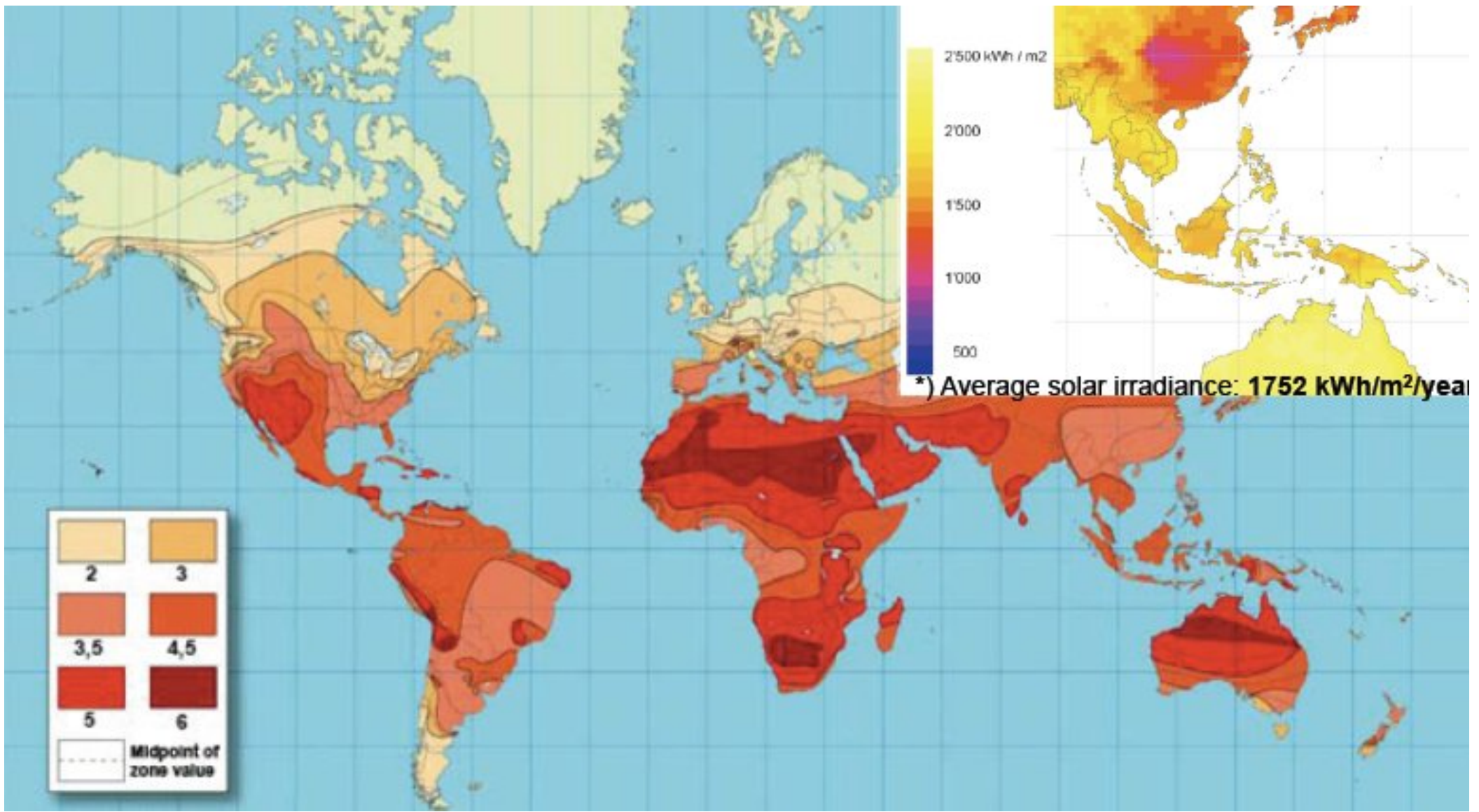


- Prof. Dr. Toto Winata (Fisika)
- Prof. Dr. Mikrajuddin Abdullah (Fisika)
- Dr. Khairul Rijal (Fisika)
- Dr. Rachmat Hidayat (Fisika)
- Dr. Sparisoma Viridi (Fisika)
- Dr. Euis Sustini (Fisika)
- Dr. Edi Leksono (Teknik Fisika)
- Dr. Brian Yulianto (Teknik Fisika)
- Dr. Ahmad Nuruddin (Teknik Fisika)
- Dr. Veinardi Suendo (Kimia)
- Dr. Abdul Halim (T. Mesin)

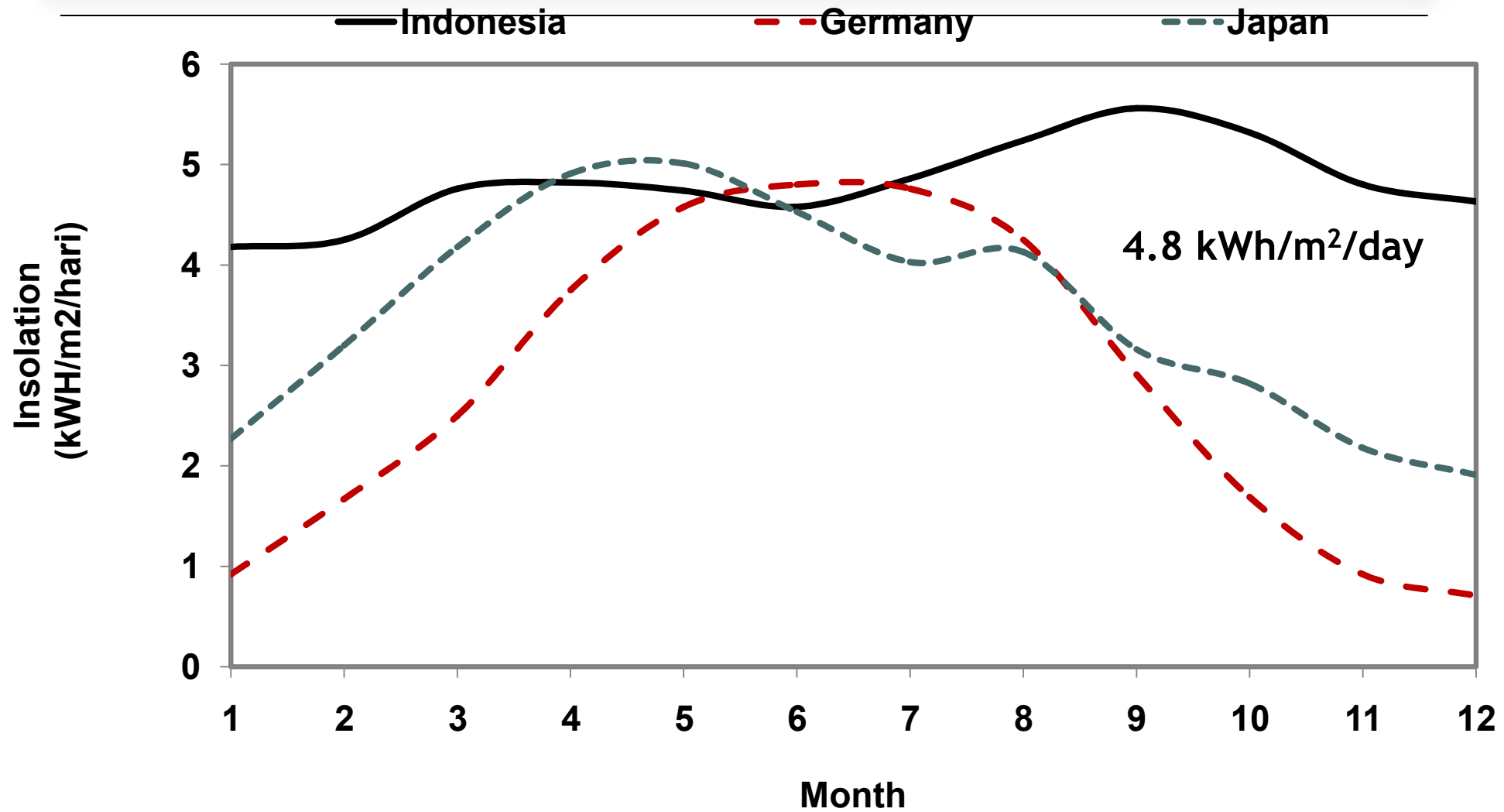
Pendahuluan – Potensi Energi Surya



Dunia

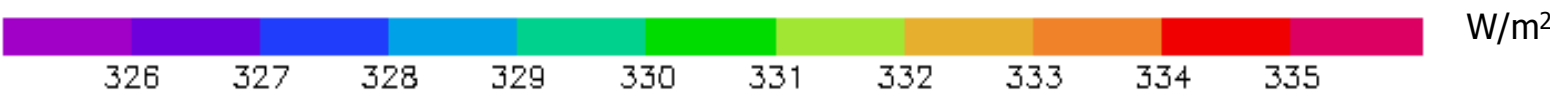
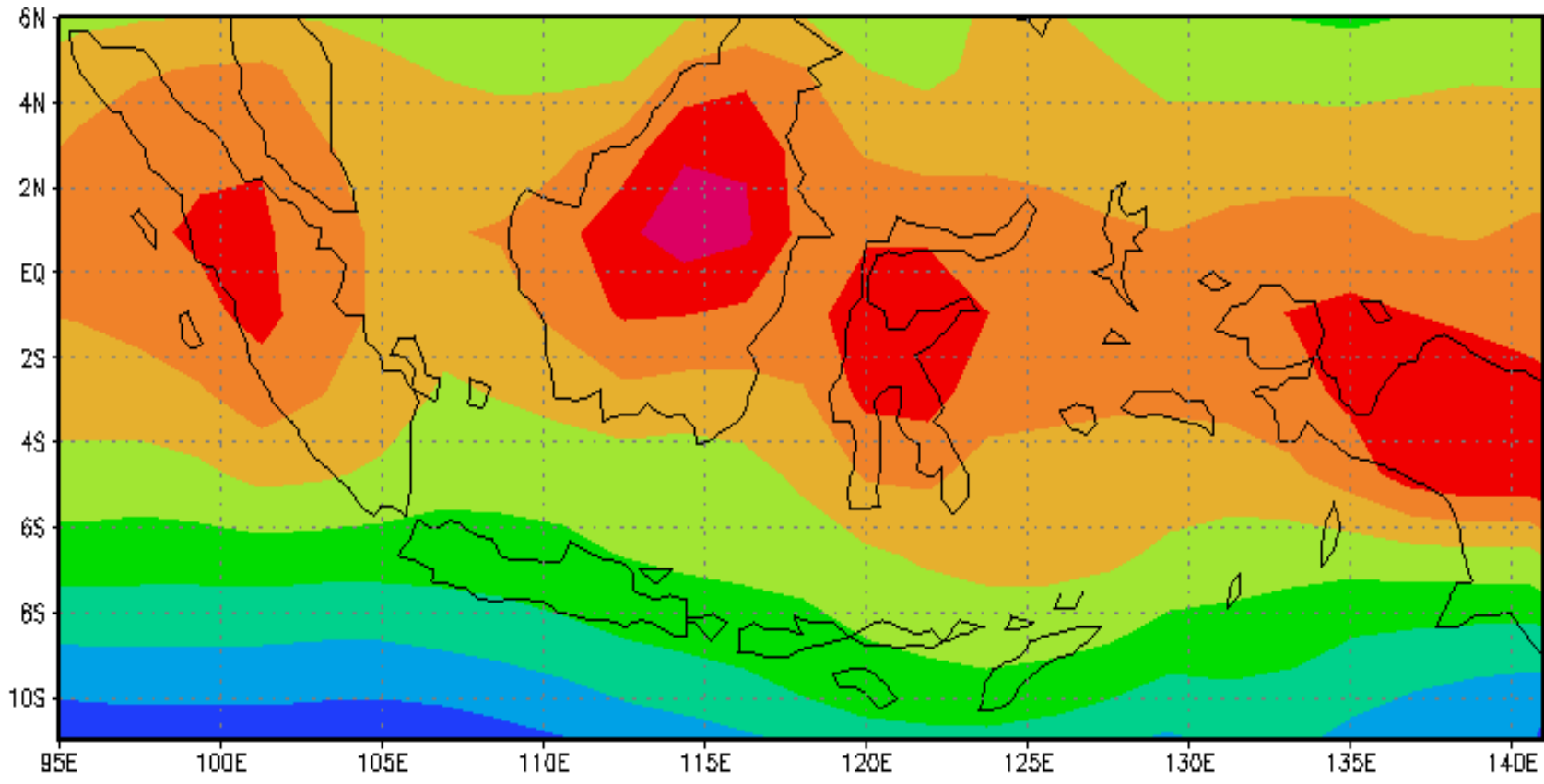


Pendahuluan – Potensi Energi Surya



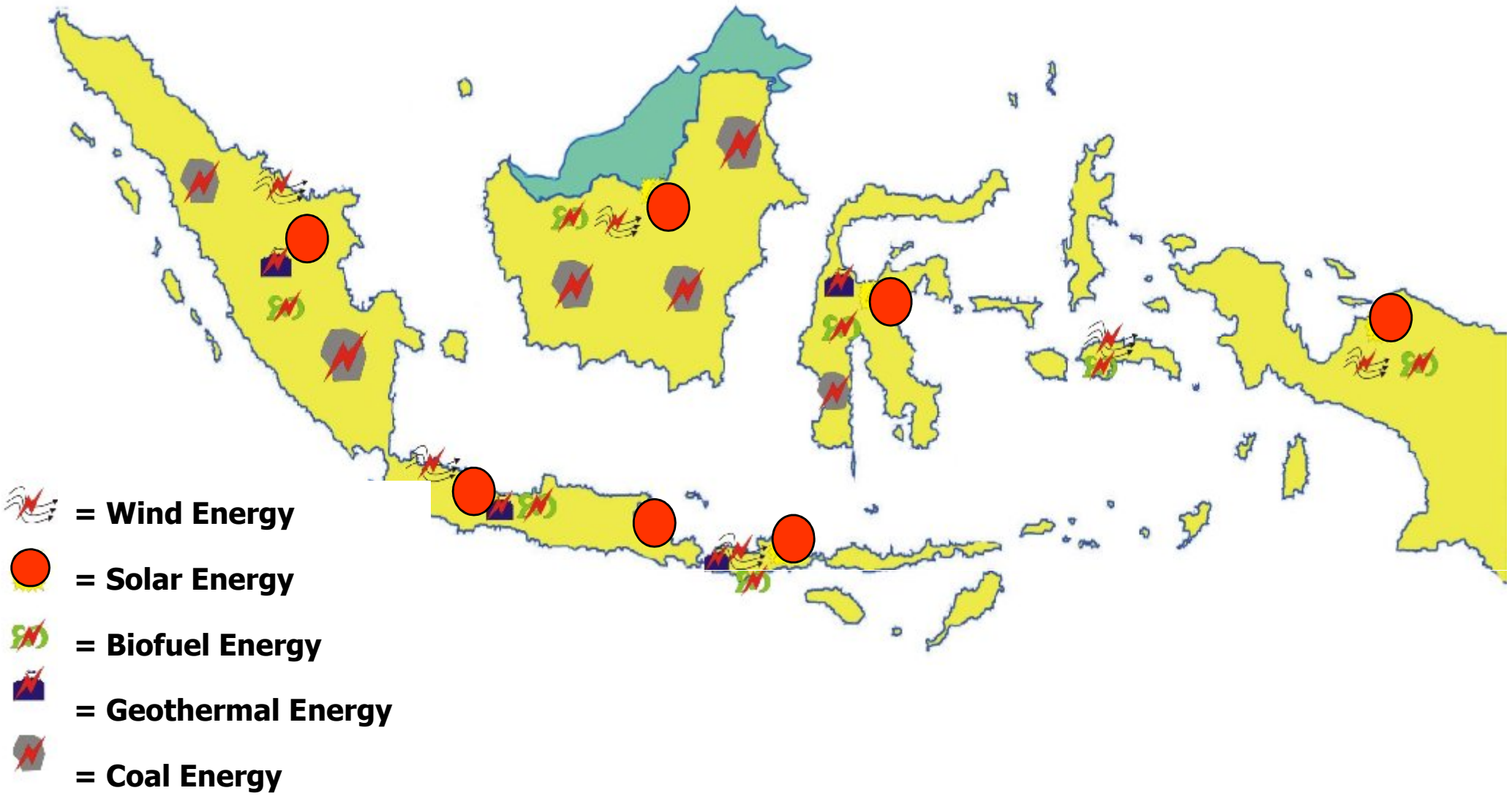
Monthly Average Insolation (NASA 1985 – 2007)

Pendahuluan – Potensi Energi Surya



Source: Susandi et al., 2008

Pendahuluan – Potensi Energi Surya

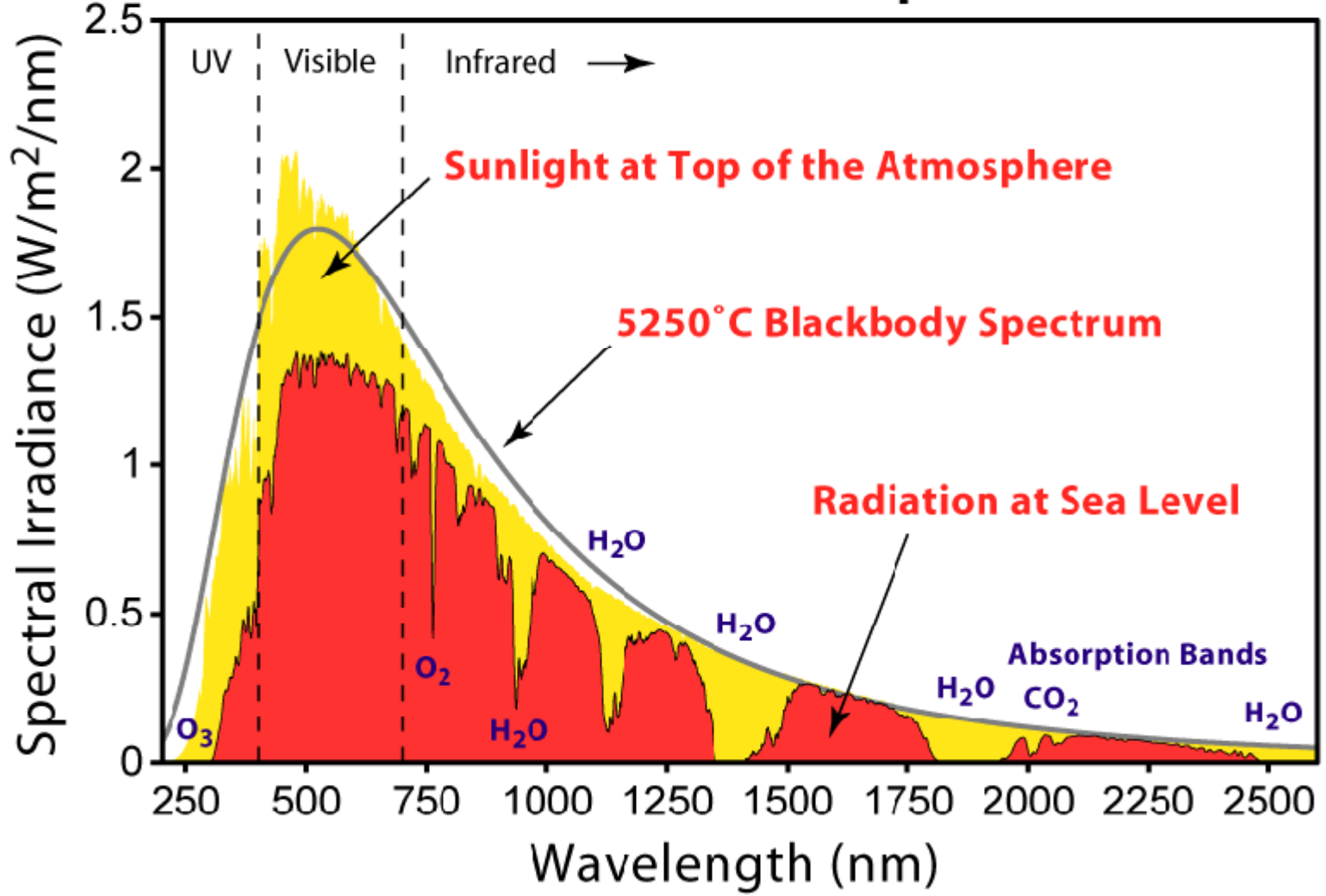


Source: Susandi et al., 2008

Pendahuluan – Divais Konversi Energi Surya



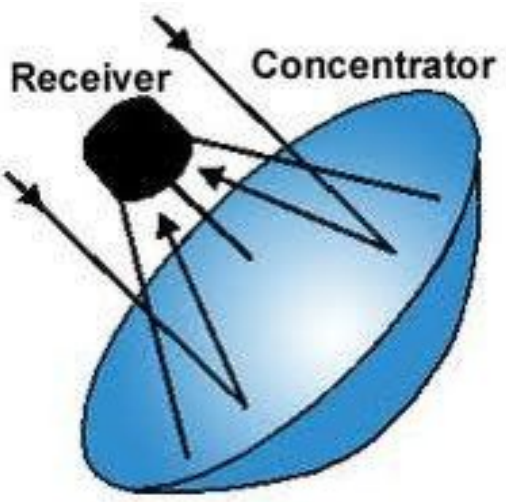
Solar Radiation Spectrum



Pendahuluan – Divais Konversi Energi Surya



Solar concentrator

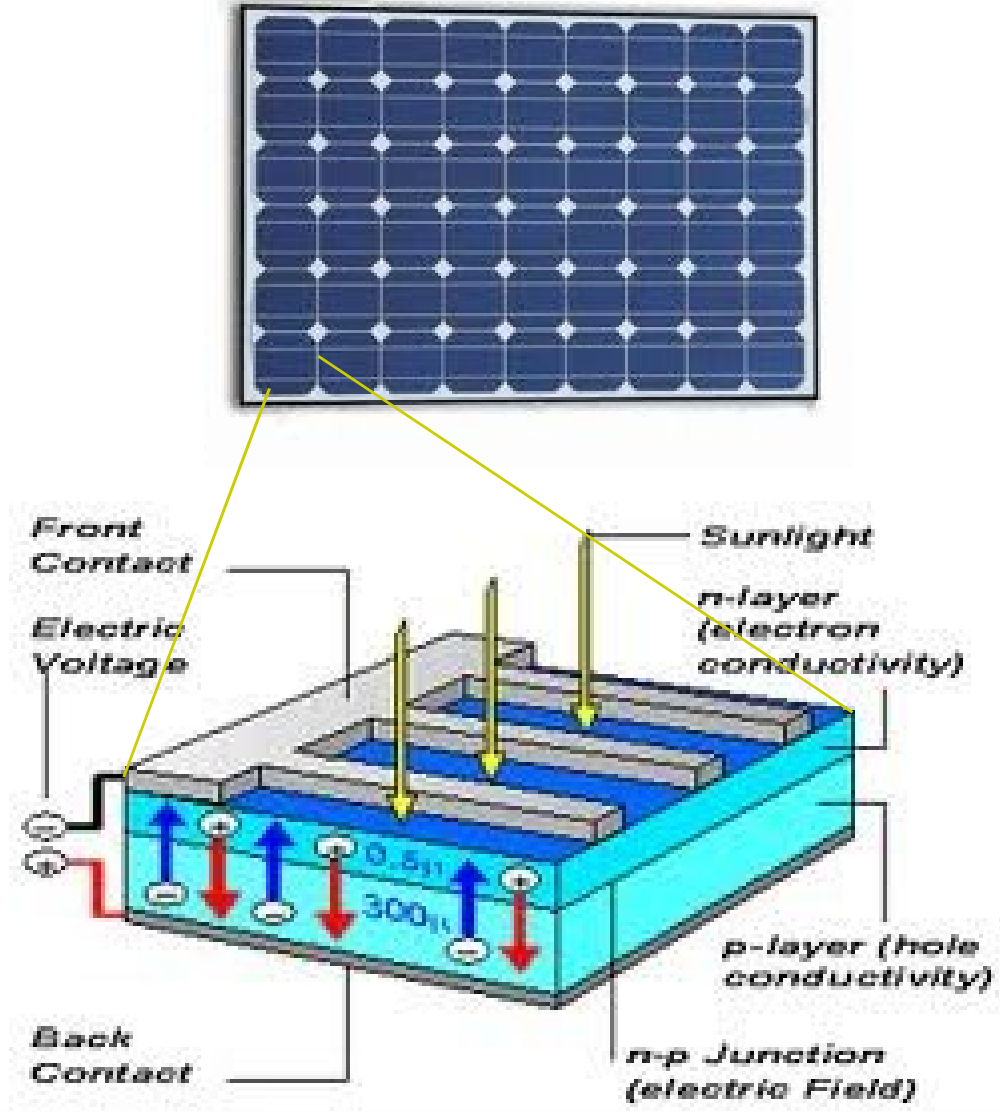
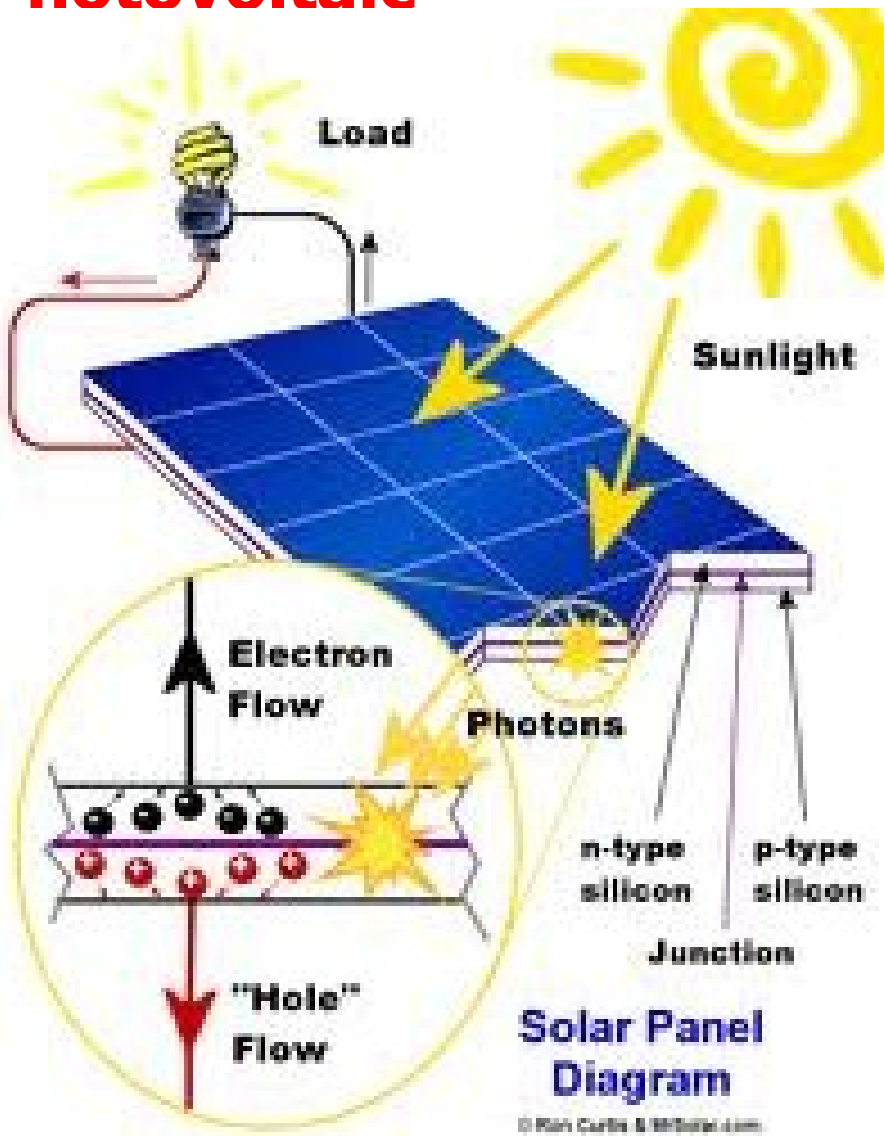


World Largest Solar Power Station in Germany

Pendahuluan – Divais Konversi Energi Surya



Solar Photovoltaic



Back contact solar cell (Courtesy: ECN, The Netherlands)

Pendahuluan – Divais Konversi Energi Surya



Types: Solar Photovoltaic

- **Crystalline (Si) based solar cells:**
 - single crystal
 - poly-crystal (multi-crystalline)
 - thin films
- Multi junction with concentrator
- Amorphous solar cells
- Dye sensitized solar cells (DSCC)
- Organic/polymer solar cells

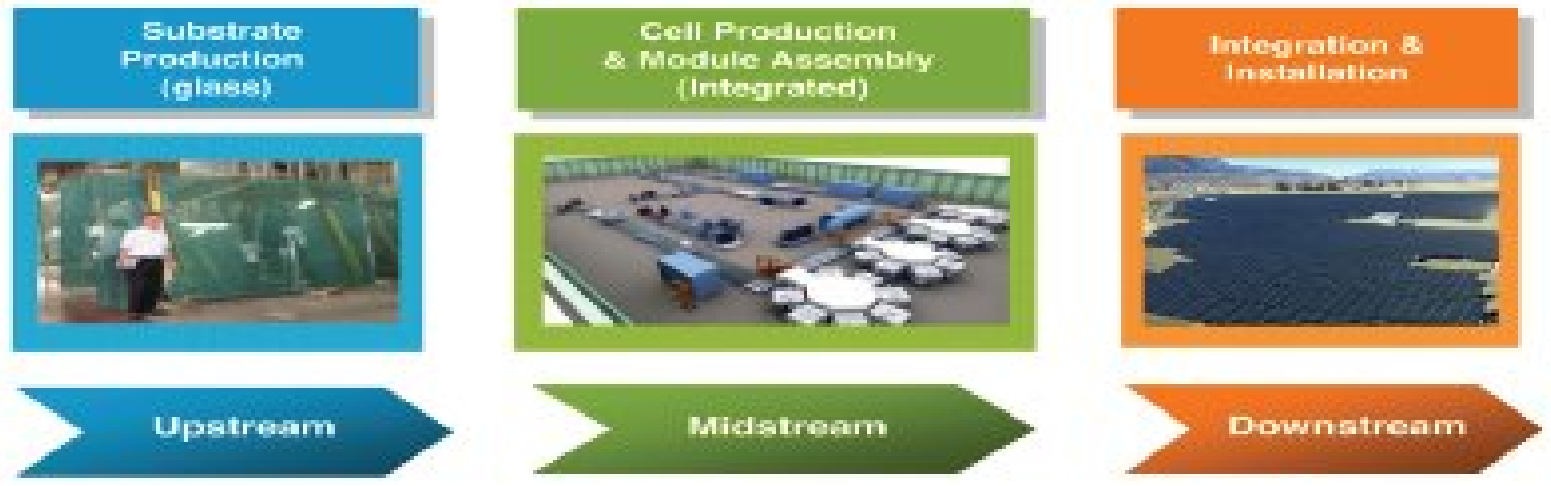
Pendahuluan – PV Production



Crystalline solar cell

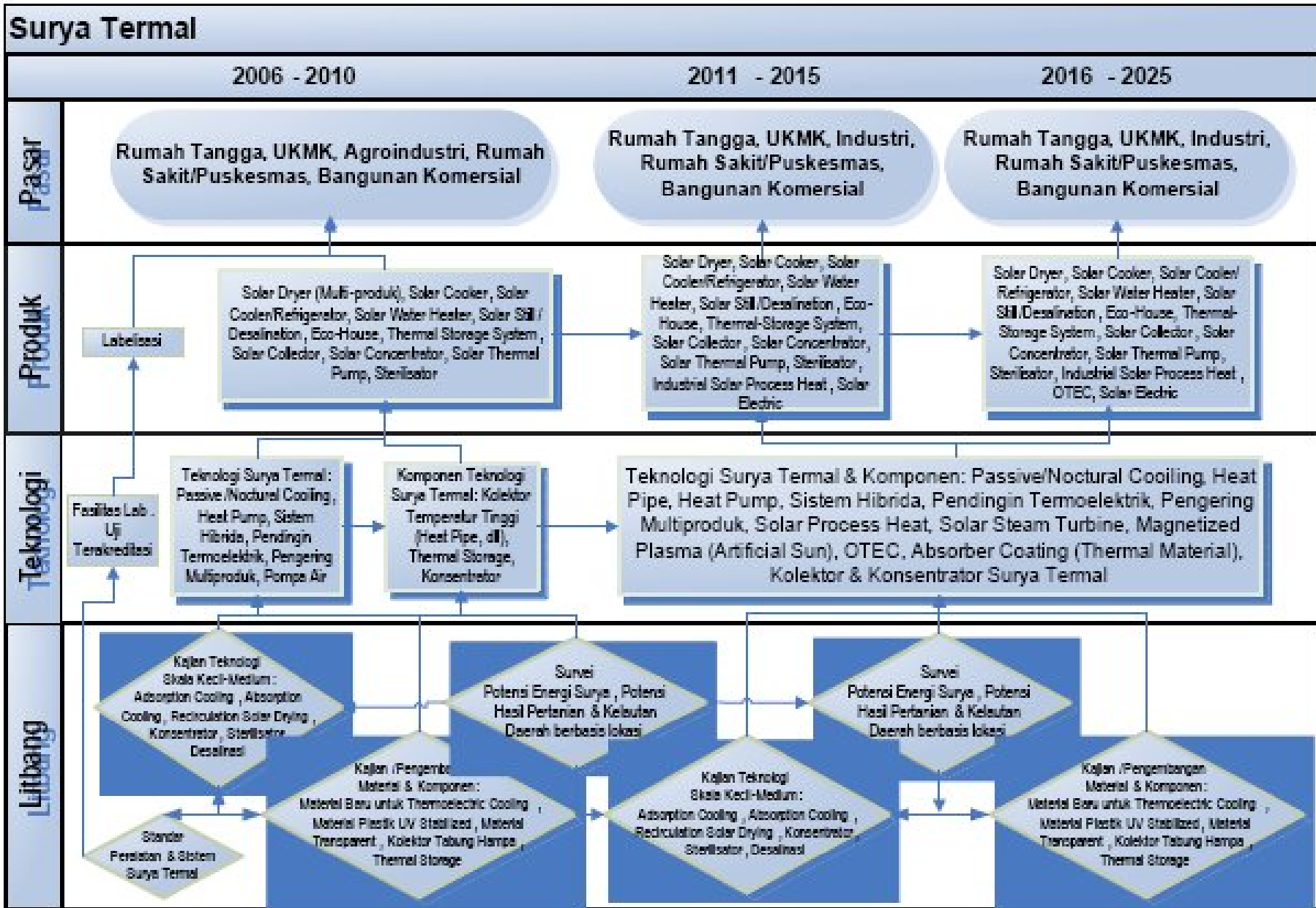


Thin Film solar cell



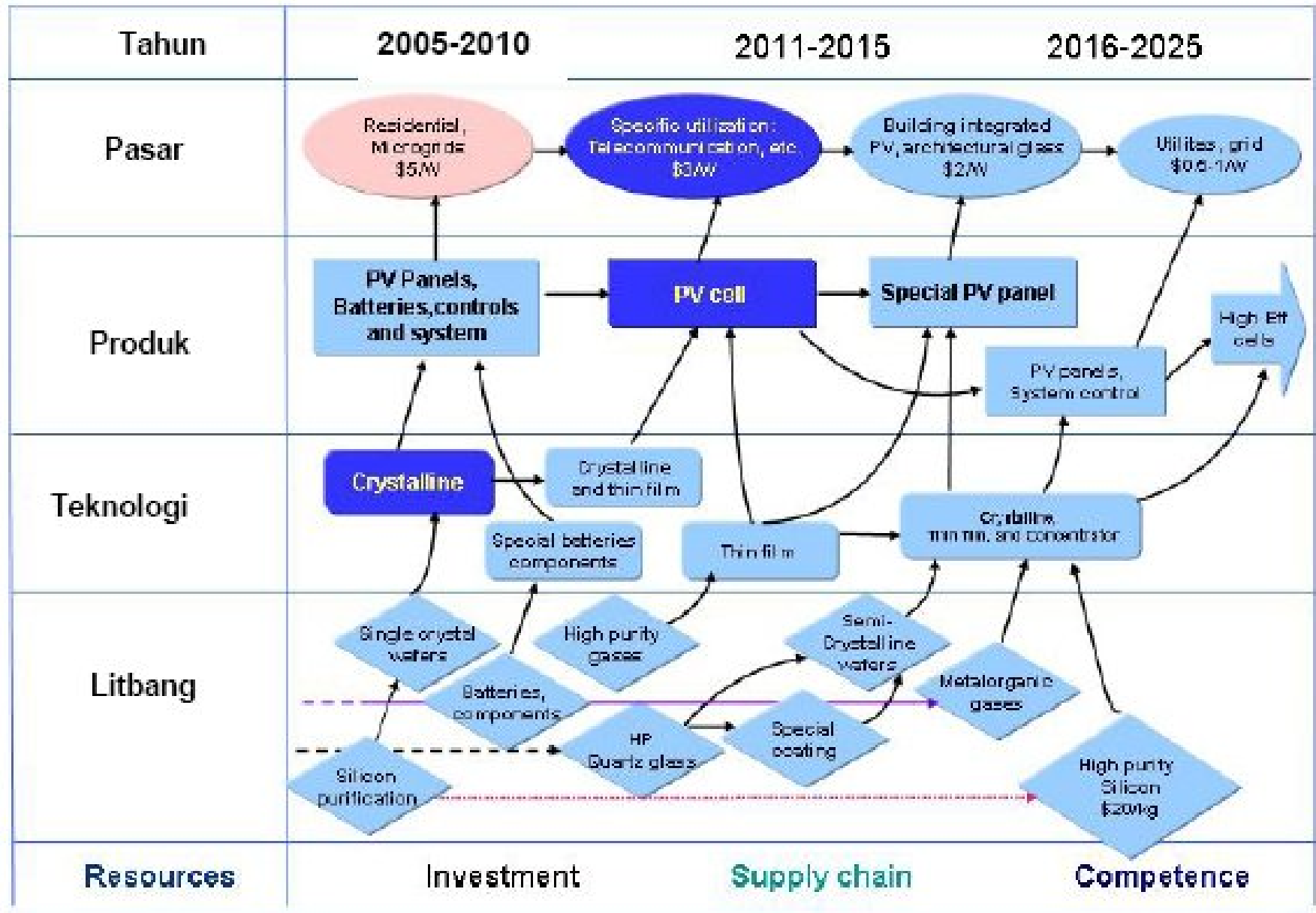


Road Map Penelitian – Surya Termal





Road Map Penelitian – Surya PV

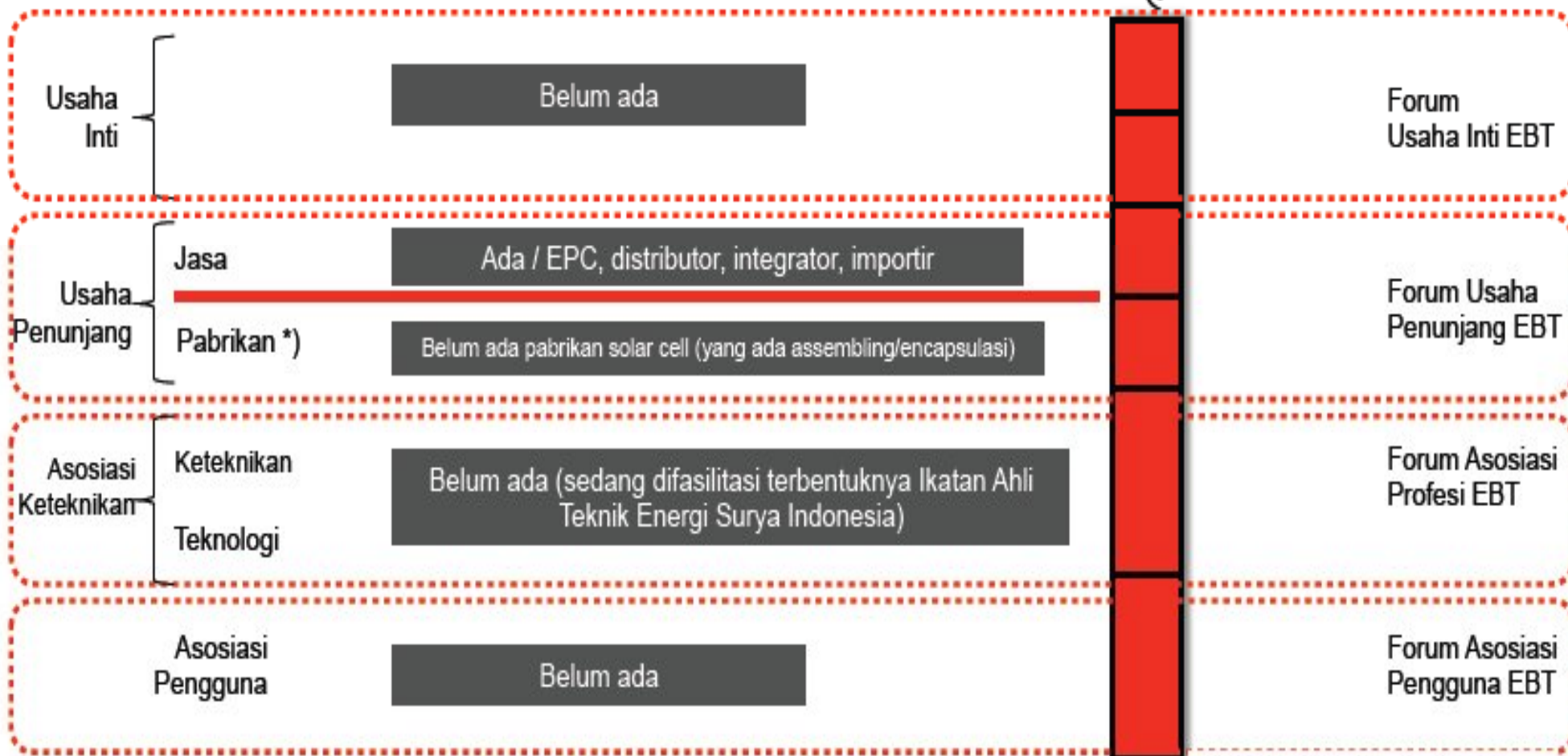


Road Map Penelitian – EBTKE 2010



KLASTER ENERGI SURYA

T4. Sinar Matahari
(Solar energy)



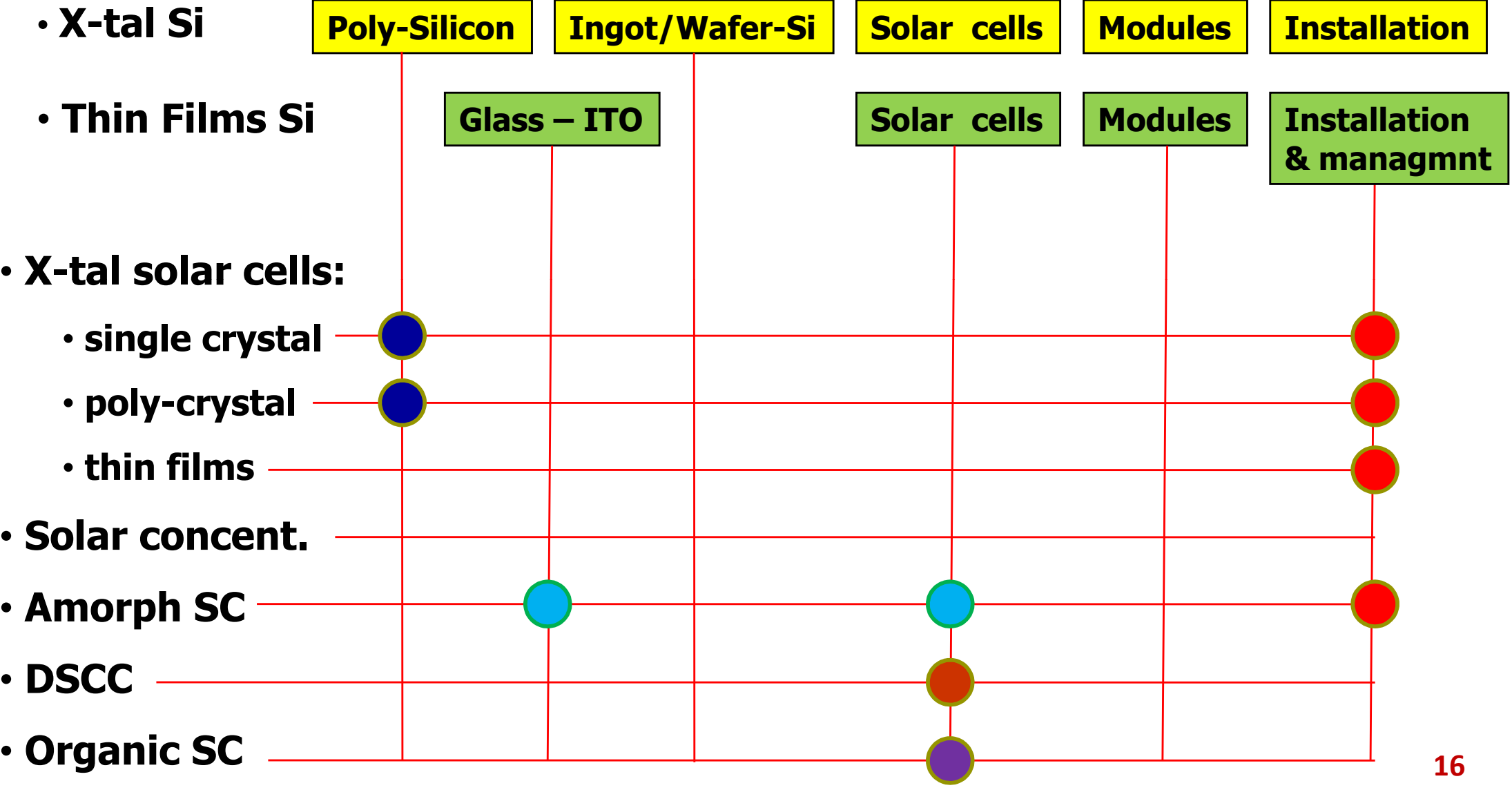
*) Untuk: - Pabrik Baterai (sudah ada)
 - Controller (PT. LEN, BPPT)
 - Inverter (belum ada)
 - Kabel (sudah ada)



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Solar cells:



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A. Nuruddin, Brian Yulianto

- **Langkat Sumatera Utara (12 juta ton), Kalimantan.**
 - 14 ton pasir silika → silikon → solar photovoltaic 1 MW listrik
 - Potensi Sumatra Utara → 850 rb MW
- **Indonesia produksi padi ~ 60 juta ton/th**
 - Sekam padi ~ 15% gabah kering → ~ 10 juta ton
 - Silika ~ 10 – 15% sekam padi → 1 juta ton

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● A. Nuruddin, Brian Yulianto (KK TF)

Ekstraksi silika dari sekam padi

- Metoda : Reduksi asam & pembakaran
- Hasil : Silika ~ 99.96 %

Sintesis Polikristalin Silikon

- Metoda : **Karbotermik**
- Hasil : **Polikristalin Si**

- Metoda : **Direct metal reduction**
- Hasil : **Kristal tunggal Si**

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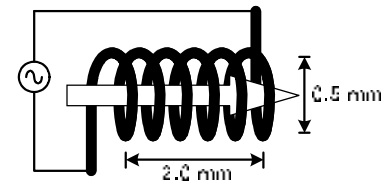
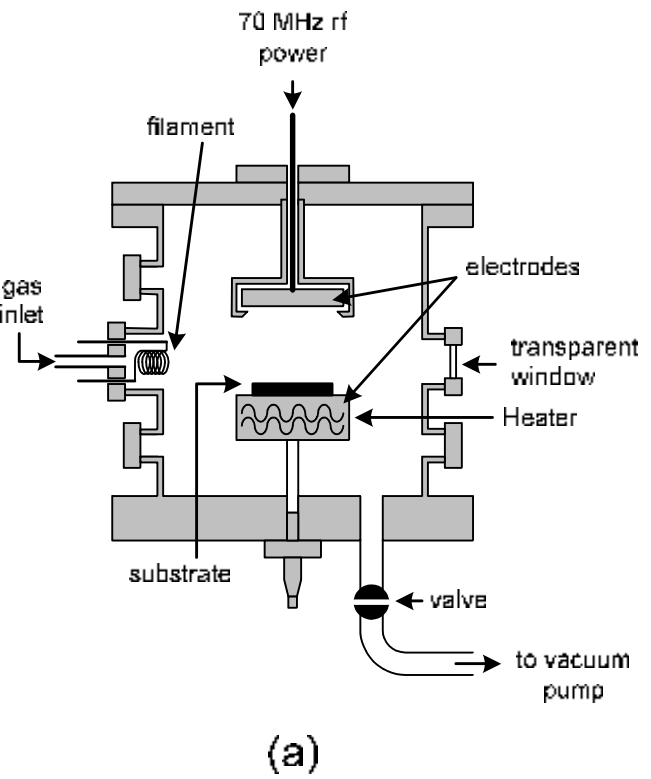


~~Toto Winata, Euis Sustini, Khairul Rijal,.... (KK Fismatel)~~

Fabrikasi Amorphous Silicon Solar Cells

Development of a new HWC-VHF-PECVD

Power ~ 34 mW/cm²; Eff.: 12.3 %

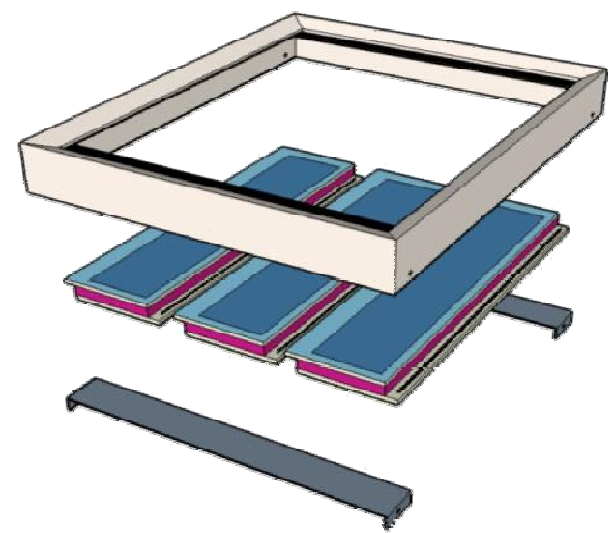
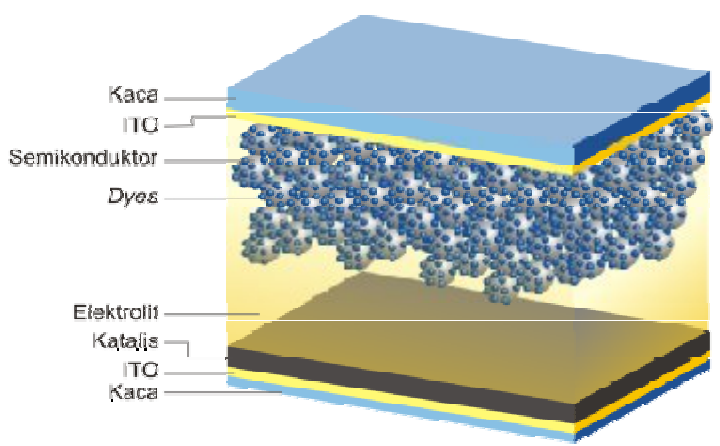
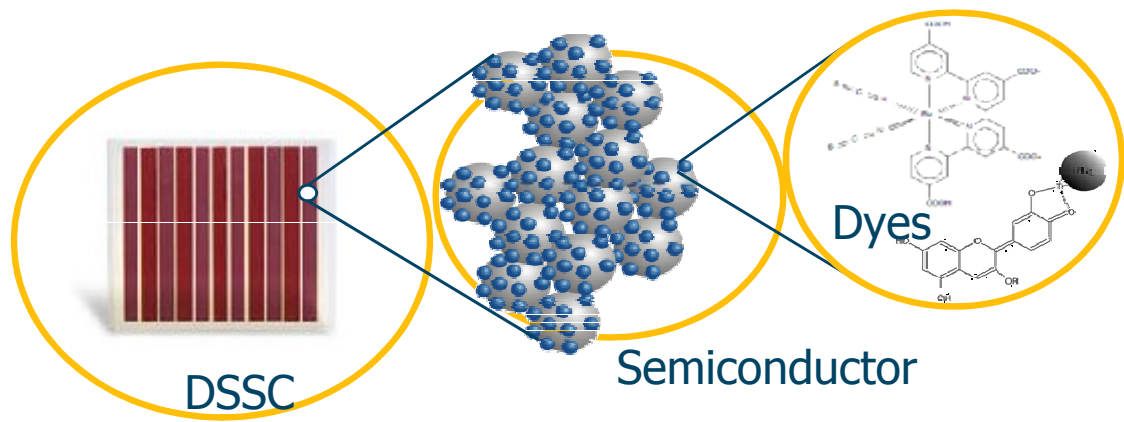


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Brian Yulianto, Nugraha.... (KK TF)

Fabrikasi Dye Sensitized Solar Cells



Active Area:
17,4 cm² / cell

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● ~~Veinardi Suendo, Sparisoma Viridi~~

Studi Organik Solar Cells

Photosystem

- Photon
- Transfer of energy
- Antenna pigment molecules
- Reaction-center chlorophyll
- Primary electron acceptor
- Electron transfer
- Reaction center

Chloroplast

- Granum (stack of thylakoids)
- Thylakoid membrane
- Cluster of pigment molecules embedded in membrane

Chemical Structure Labels:

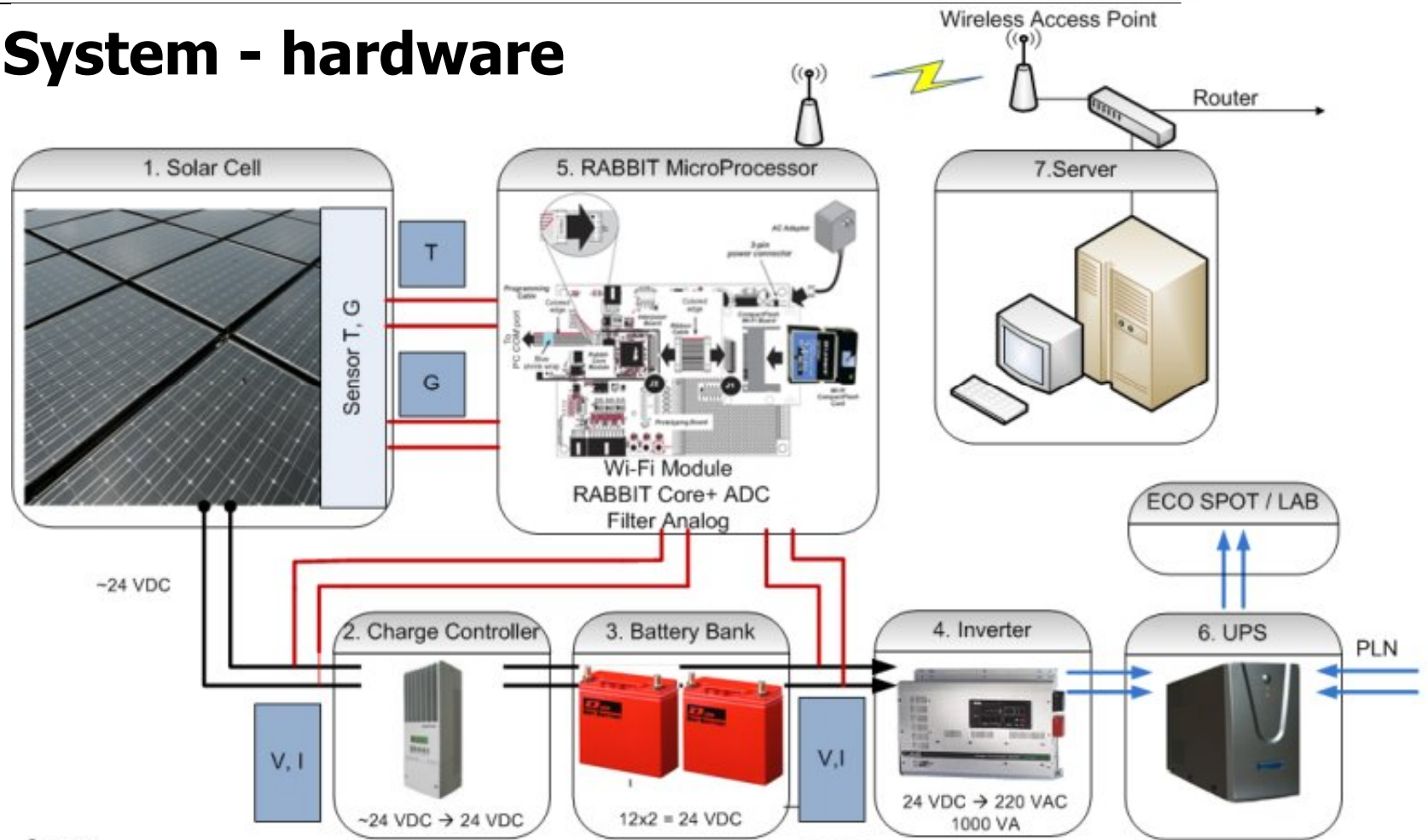
- CHO in chlorophyll *b*
- CH₃ in chlorophyll *a*
- Mg (Magnesium)
- Porphyrin ring (light-absorbing "head" of molecule)
- Hydrocarbon tail (H atoms not shown)

Klaster Energi Surya ITB - Kontributor



● ~~Edi Leksono, E. Yulianto, R.J. Widodo,...~~

Photovoltaic System - hardware



Catatan:

- 10 Pasang panel surya @ 24 VDC
- Xantrex Solar Charge Controller XW-MPPT60-150
- 2 buah Battery Haze@ 12VDC 95 Ah
- Mobile Power - Power Inverter 1000 VA -12V/24V DC à 220 VAC 50Hz
- RABBIT RCM 3700, Rabbit Core 3000, Wireless LAN 802.11b Module
- UPS Prolink Pro1200 Watt
- Monitoring Server (energy.tf.itb.ac.id)

Catatan:

- Rangkaian Sensor (Sensor Radiasi (G) HAENI MESSGERAETE, Sensor Temperatur (T) LM35, Sensor Arus (I) Alegro ACS-754 100A DC)
- Listrik 220 VAC
- 24 VDC
- Sinyal Sensor 0 - 20 VDC



Klaster Energi Surya ITB - Kerjasama



ITB - Fraunhofer Institute – Bappeda Jabar

→ Studi implementasi PV system untuk remote area

ITB-Bappeda Jabar

→ Implementasi system monitoring 1 kW PV di Bappeda Jabar

ITB-Ristek-LIPI

→ Pengembangan & fabrikasi sel surya berbasis silikon

ITB - KemenPU

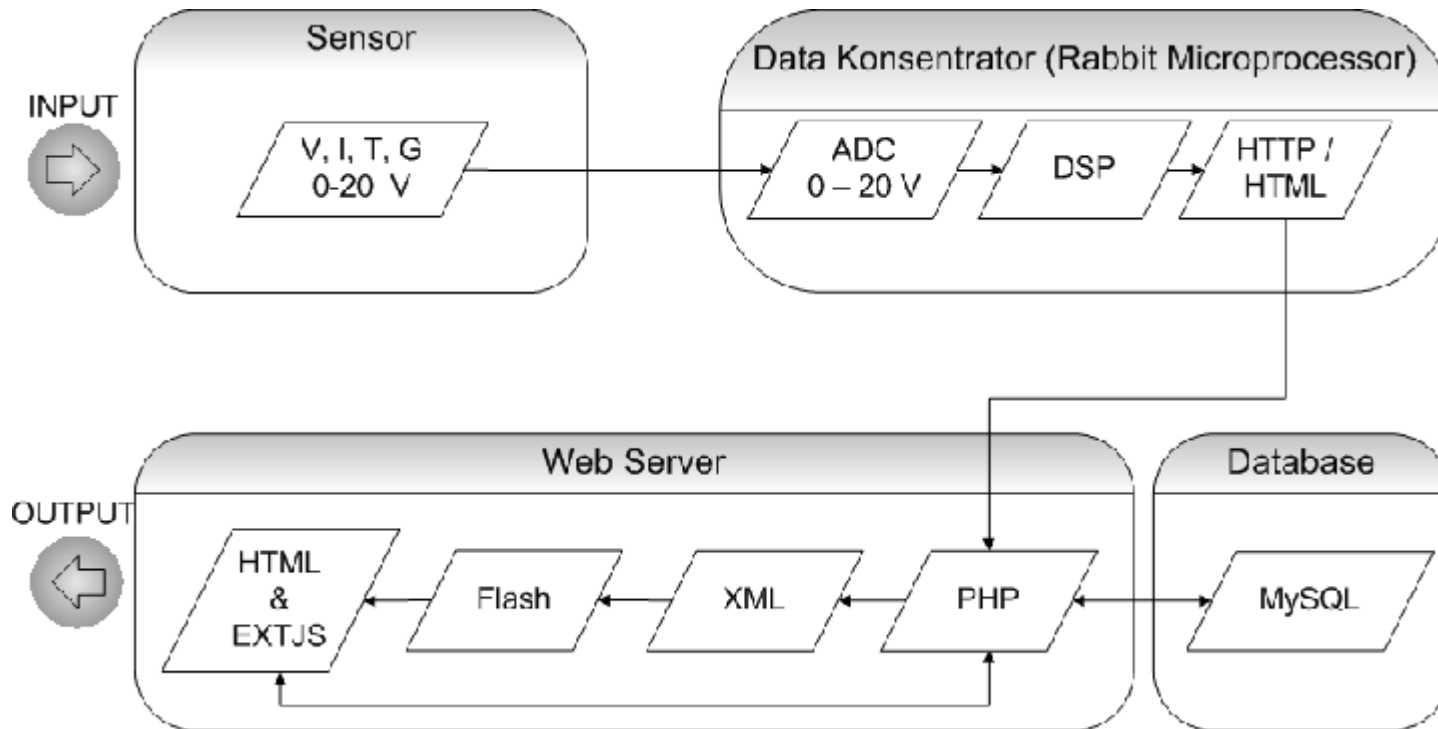
→ Prototipe Hybrid system PV untuk jembatan bentang panjang
(Suramadu, 30 kW)

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● **Edi Leksono,.....**

Photovoltaic System - software



- *Free and Open Source Software (FOSS).*
 - Sistem Operasi Linux **Ubuntu**.
 - Web Server **Apache HTTP**.
 - Client Side Presentation, **ExtJS**.
 - Server Side Business Logic, **Hypertext Preprocessing (PHP)**.
 - Back End Storage, **MySQL**.

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● ~~Uni2..., BPPT, LIPI, LEN,...~~

- **LEN – Assembling poly x-tal solar cells**
- **LIPI – Fabrikasi poly x-tal solar cells (Eff. 13% lab.)**
- **Uni2, BPPT – Pemurnian pasir silika → poly Si ingot**

Ringkasan



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-
- **Pemanfaatan solar sel mulai memasyarakat : supporting energi**
 - **Pengembang divais untuk memanen energi surya (PV, Bateri, Konverter) masih berjalan sendiri²**
 - **Pengembang PV/solar cell masih pada tahap awal (belum produksi)**



Terimakasih