



Smart Grid Initiative and Roadmap In Thailand

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Provincial Electricity Authority

@Sixth GMSARN
Grand Paradise Hotel
28-30 March, 2012



Outline

1. PEA Profile
2. PEA Smart Grid Vision
3. Present and Future Power System
4. Driver
5. Some of Recent Concerns
6. Smart Grid ICT Architecture
7. Smart Grid Building Block
8. Challenges in SG Implementation
9. Features of a Smart Grid
10. Reasons for Renewable Energy
11. Status of AMR/AMI in PEA
12. PEA Smart Grid Roadmap
13. Some PEA Smart Grid Investment Projects



1. PEA Profile

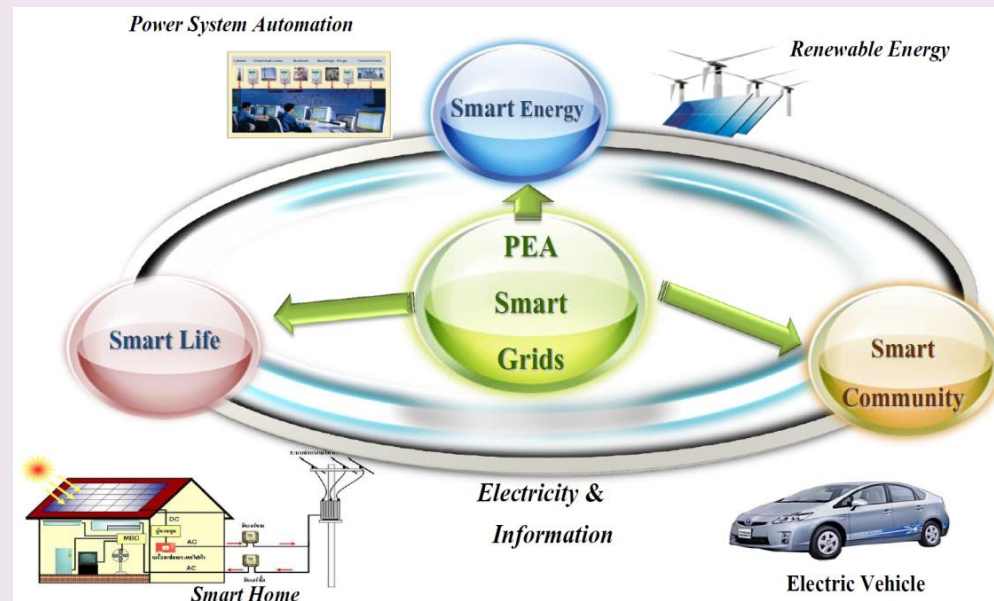


Service Area	510,000	km ²
Electrified Village	99.98	%
Customer	16.02	Millions
Peak demand	16,000	MW
HV (115 kV) Line	9,639	km
MV (22 & 33 kV) Line	298,996	km
LV (220/380 V) Line	464,167	km
Office	901	
Employee	28,024	
Total Loss	4.62	%



2. PEA Smart Grid Vision

PEA Smart Grids focus is to improve quality of life while maintaining the environment.





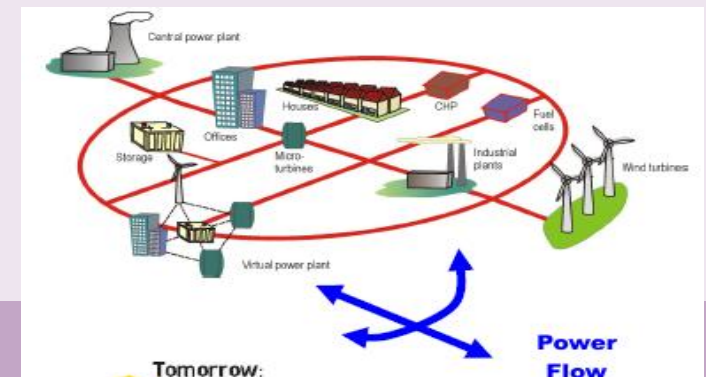
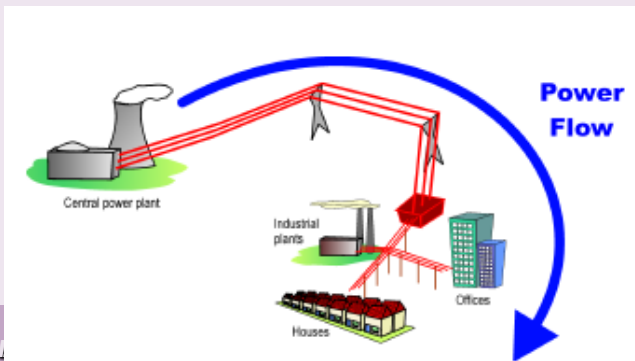
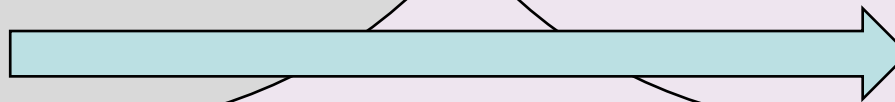
3. Present and Future Power System

Present Power System

- Heavily Relying on Fossil Fuels
- Generation follows load
- Limited ICT use

Future Power System

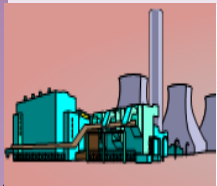
- More use of RES, clean coal, nuclear power
- Load follows Generation
- More ICT & Smart meter use





Green Power

- Build with technology innovation for a green power system starting from generation, transmission, distribution to sales
- Increase energy efficiency and reduce Green House Gas emissions
 - *Core Business Strategy aiming at sustainable growth*



Generation

- Expansion of nuclear, renewable energy
- IGCC and CCS
- High efficiency at generation facility

Transmission

- Digital Substation supported by IT
- Green, high-efficiency new materials

Distribution

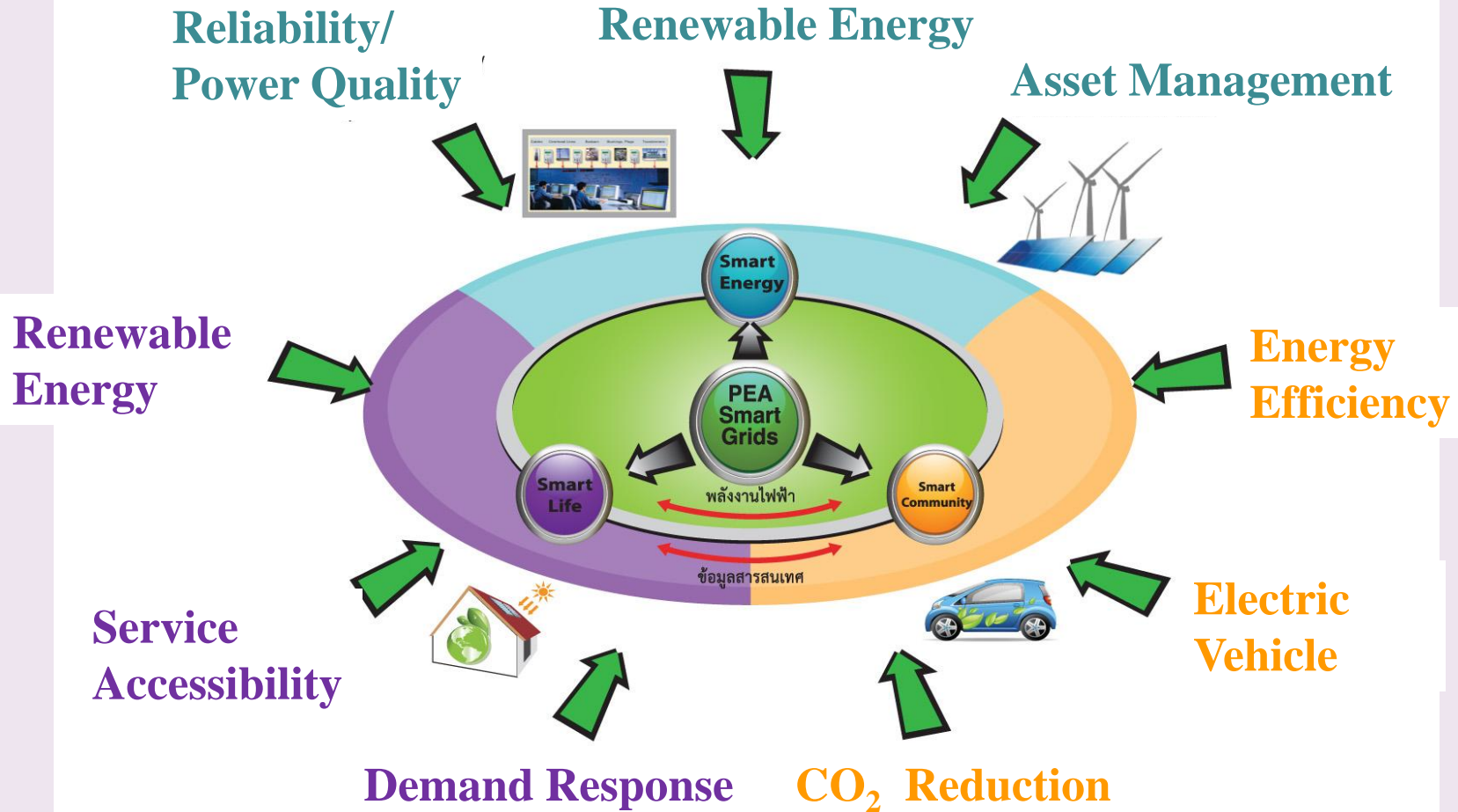
- Smart Grid
- Better Demand Management
- EV Infrastructure

Business

- Smart building
- All-electricity homes
- Heat pump
- Applying green products



4. Driver



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5. Some of the Recent Concerns

- Limited expansion of transmission network as compared to the generation addition.
 - Most of the generation, T&D systems have become old.
- Increased T&D Losses
- Lack of dynamic data for health monitoring and control

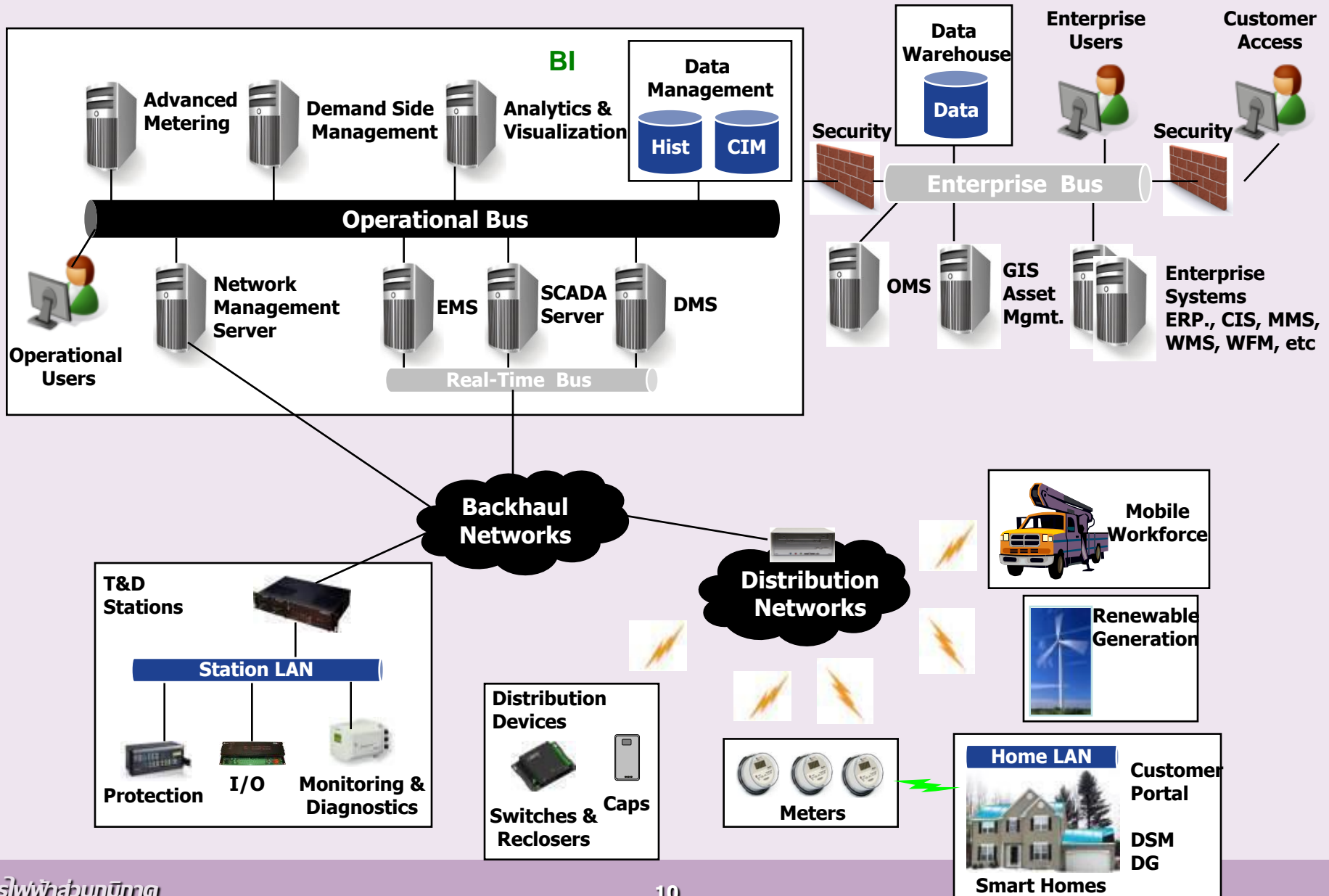


5. Some of the Recent Concerns (cont')

- Increased concern towards vulnerability and resilience of the system under natural and man made disasters.
- Growing environmental concerns including the global warming.
- Poor power quality, limited customer focus and their participation in energy management.
- Meeting the ever increasing electricity demand.



6. Smart Grid ICT Architecture





7. Smart Grid Building Block

- **Advanced Metering & Communication**
 - Smart Meter (Single phase & poly-phase), 2-way communication, interface to enterprise applications, Wide Area Monitoring System.
- **Distribution Automation**
 - Fault Detection, Isolation, Restoration (FDIR), Integrated Volt/VAR management, including switched capacitors & voltage regulator
- **Substation Automation / M&D**
 - Substation controller and transformer monitoring and diagnostics



7. Smart Grid Building Block (Cont')

- **Distribution Operations**
 - DMS/OMS Software and interface to existing applications, control center digitization, and enterprise integration.
- **Utility Enterprise Applications**
 - Electric, Gas & Telecommunications utility geospatial based applications, DSM application, and advanced analytics & visualization
- **System Integration**
 - Enterprise Service Bus with adapters to all building blocks



8. Challenges in SG Implementation

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- Increase in system operational complexity
- More business oriented attitude
- Large data handling
- Information security
- Requirement of accurate forecasting approaches
- Cost-effecting implementation, including ICT
- Utilization of Demand Response
- Redesigning of electricity market structure
- Fast analysis tools
- Power Quality

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9. Features of a Smart Grid

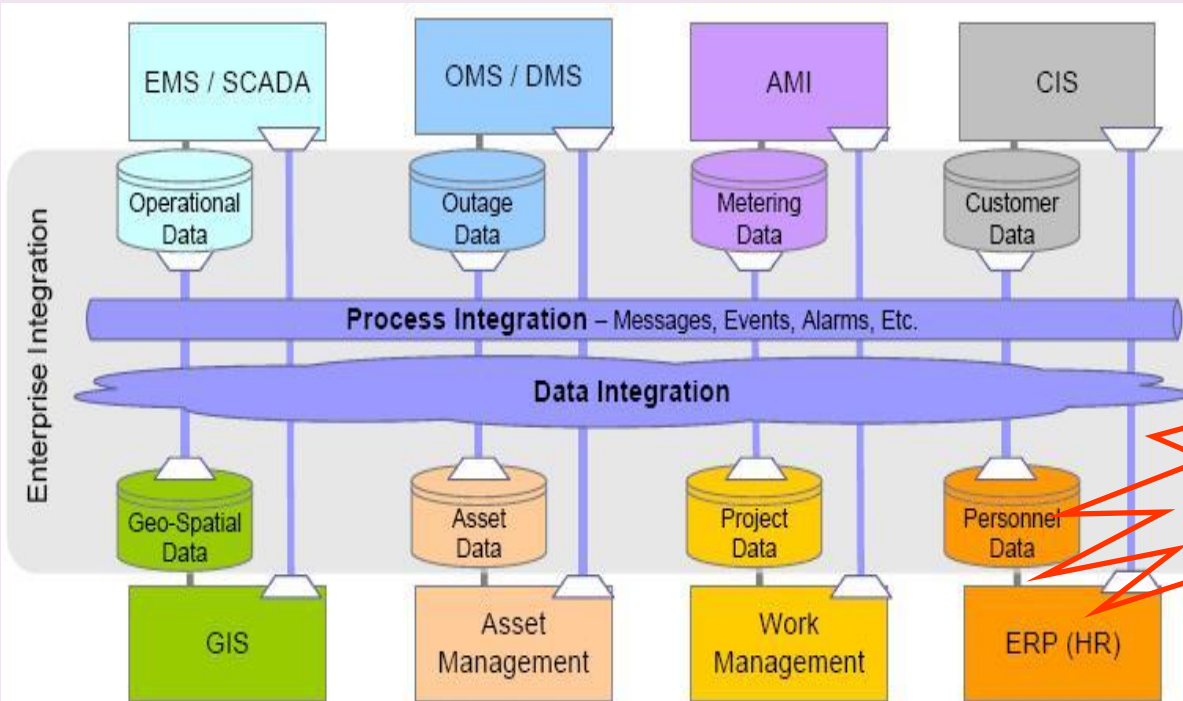
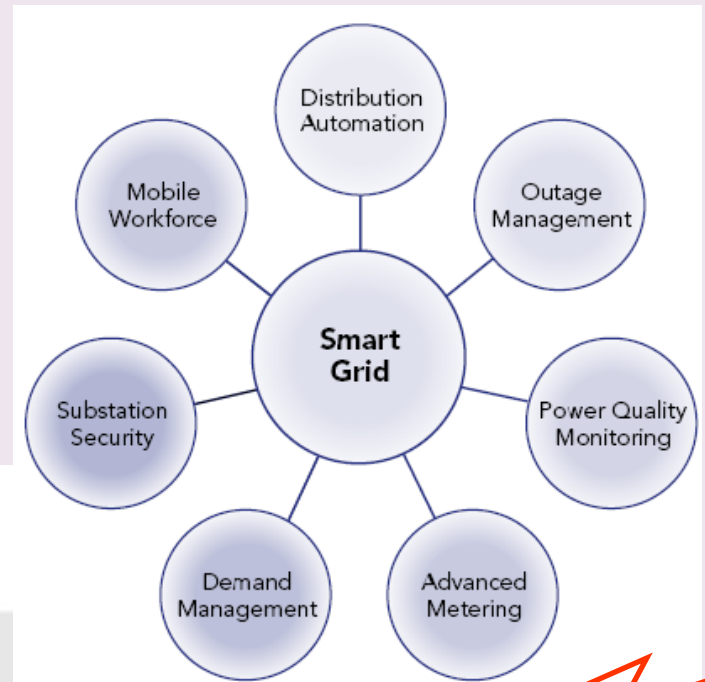
- **Self-Healing** to correct problems early
- **Interactive** with consumers and markets
- **Optimized** to make best use of resources
- **Predictive** to prevent emergencies
- **Distributed** assets and information
- **Integrated** to merge all critical information
- **More Secure** from threats from all hazards

Ref : DOE



Critical issues

- Interoperability
- Security
- Data Management
- Data Integration



**Interoperability
Security**





10. Reasons for Renewable Energy : Why & Why Now?

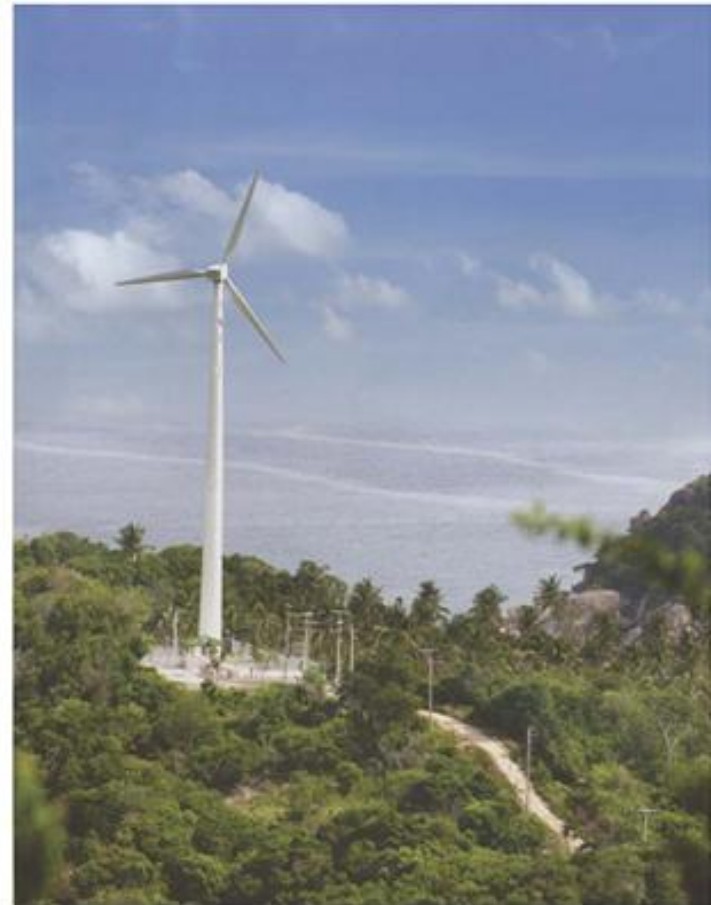
- Declining Fossil Fuel Supplies
- Environmental* Concerns (Kyoto Protocol, 1997)
- Increasing Cost of Fossil Fuels
- Business Opportunities
- Energy Security
- Energy Independence

** 1 MW of wind plant in one year can displace 1,500 tons of CO₂, 6.5 tons of SO₂ and 3.2 tons of NO_x (REPP report, Washington July 2003)*



10. CO₂ Reduction Projects : Wind

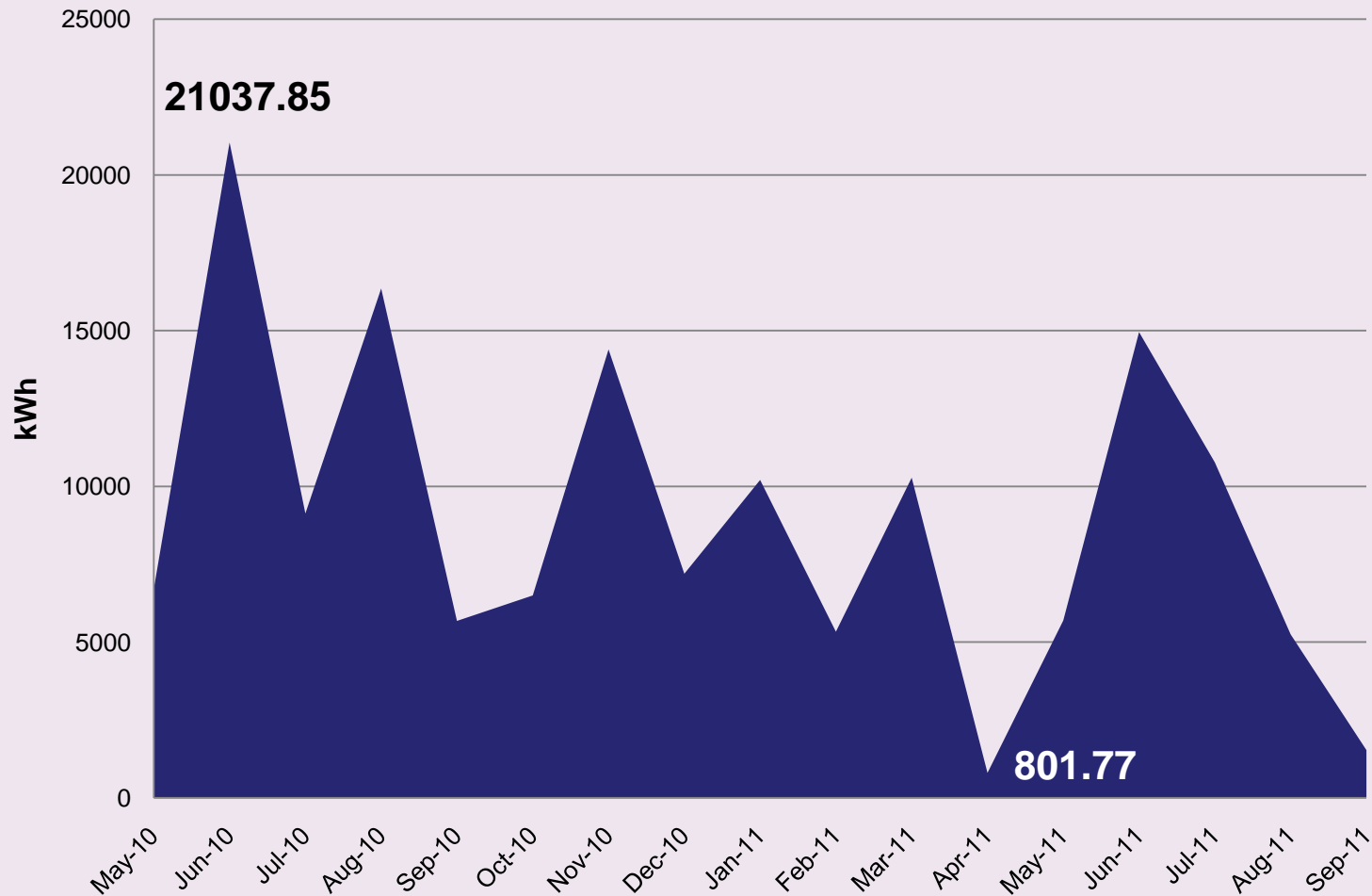
250 kW Wind Turbine at Koh Tao, SuratThani





10. CO₂ Reduction Projects : Wind

Electricity from Wind at Koh Toa



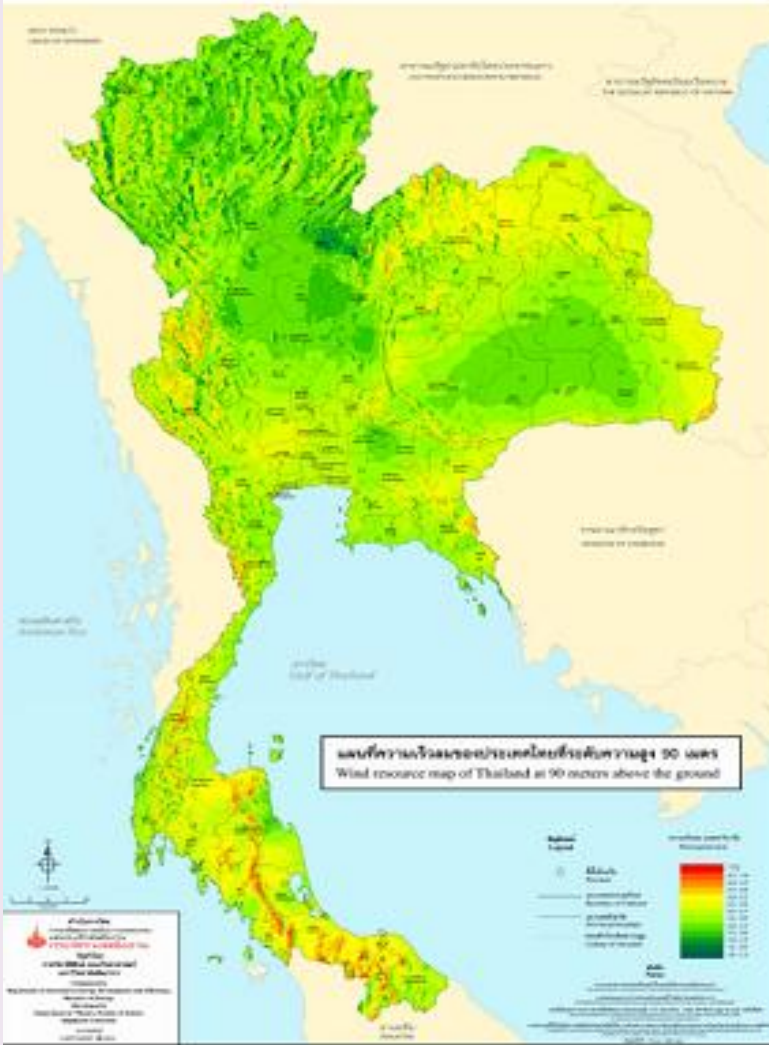
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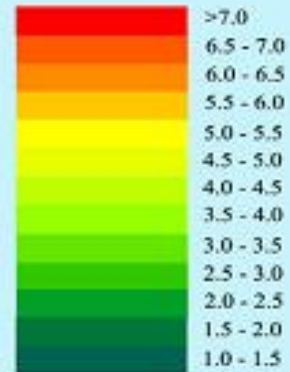
10. CO₂ Reduction Projects : Wind

Wind Energy Potential in Thailand



แผนที่ความไว้มของประเทศไทยที่ระดับความสูง 90 เมตร
Wind resource map of Thailand at 90 meters above the ground

ความไว้ม (เมตร/วินาที)
Wind speed (m/s)



แผนที่ความไว้มของประเทศไทยที่ระดับความสูง 90 เมตร
Wind resource map of Thailand at 90 meters above the ground



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กรมพัฒนาพลังงานทดแทน
และอนุรักษ์พลังงาน
กระทรวงพลังงาน
พัฒนาโดย
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ภาควิชาฟิสิกส์ คณะวิทยาศาสตร์
มหาวิทยาลัยศิลปากร

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Department of Alternative Energy Development and Efficiency,
Ministry of Energy
Developed by
Solar Energy Research Laboratory,
Department of Physics, Faculty of Science,
Silpakorn University

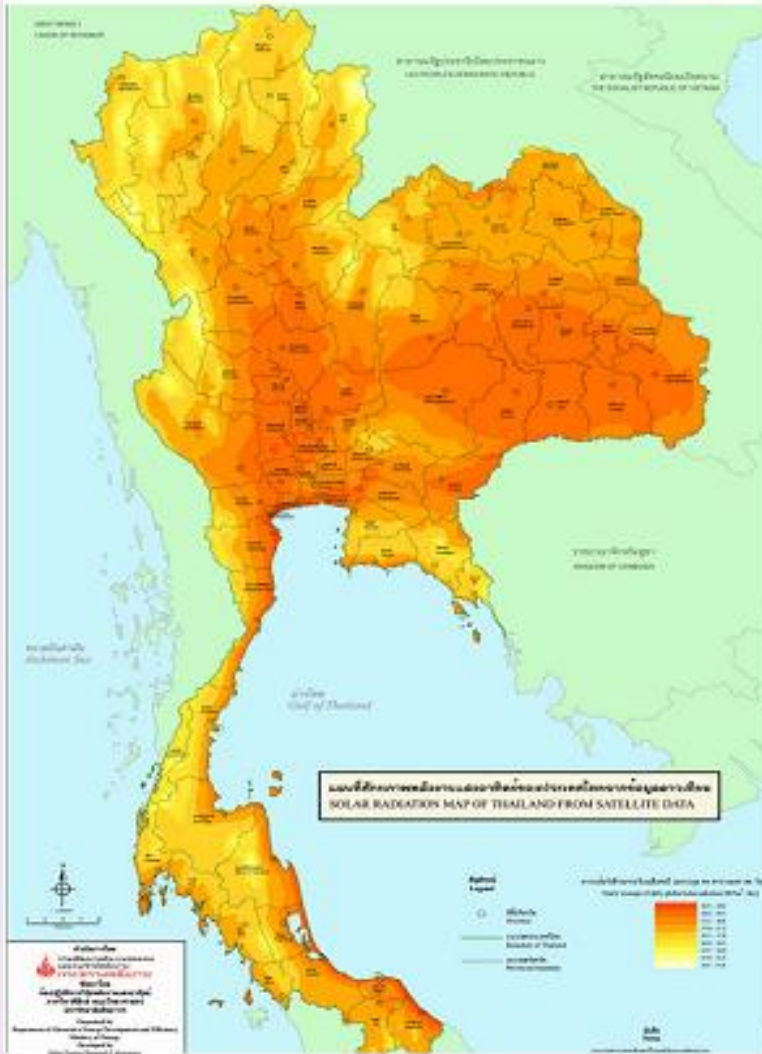
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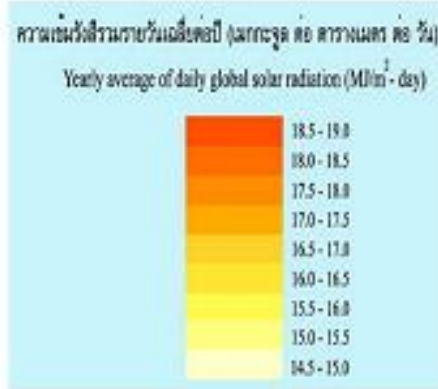
10. CO₂ Reduction Projects : PV

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Solar Energy Potential in Thailand



แผนที่ศักยภาพพลังงานแสงอาทิตย์ของประเทศไทยจากข้อมูลดาวเทียม
SOLAR RADIATION MAP OF THAILAND FROM SATELLITE DATA



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มหาวิทยาลัยศิลปากร

Organized by
Department of Alternative Energy Development and Efficiency,
Ministry of Energy
Developed by
Solar Energy Research Laboratory,
Department of Physics, Faculty of Science,
Silpakorn University

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Source : EPDO



10. CO₂ Reduction Projects : Biomass

Biomass Potential in Thailand

Type of Biomass	Generation (MW)
Paddy Husk	700
Straw	650
Bagasse	900
Top, Trashier and bagasse of Industrial sugarcane	570
Fiber, shell and Empty bunches of oil palm	70
FronD and leaves Wood	40
Cassava root	70
Corn maize	70
Source : Ministry of Energy	Total 3,070

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10. CO₂ Reduction Projects : SPP/VSPP

Status of Power Purchase from SPP/VSPP

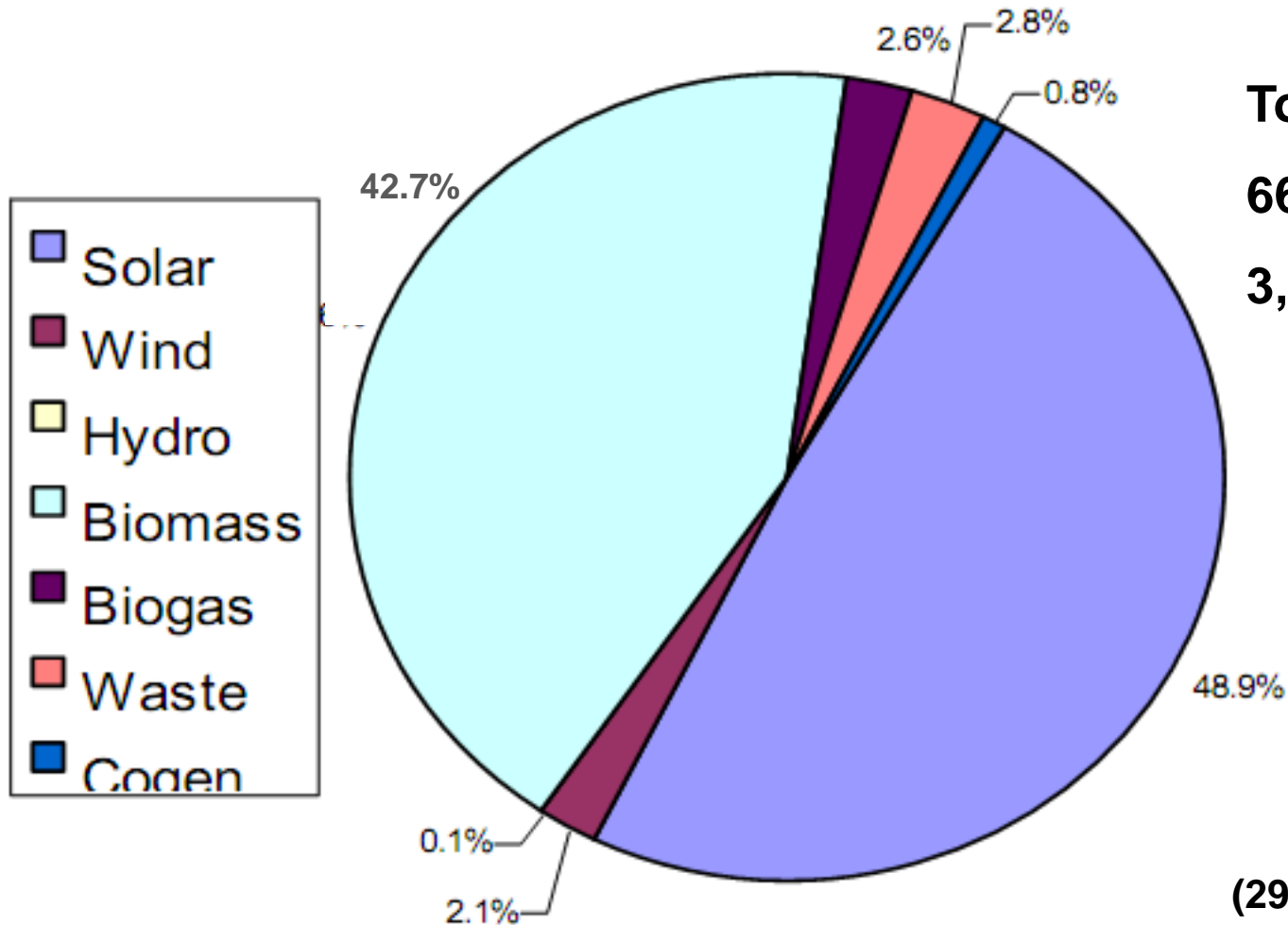
(29 February, 2012)

Detail	No. of Project	Proposed Sales To PEA (MW)
Currently Supplying Power to the Grid	222	618
PPA Signed	665	3,358
Received Notification of Acceptance	117	343
Submitted Proposals	275	1278
Total	1,279	5,597



10. CO₂ Reduction Projects : SPP/VSPP

PPA Signed



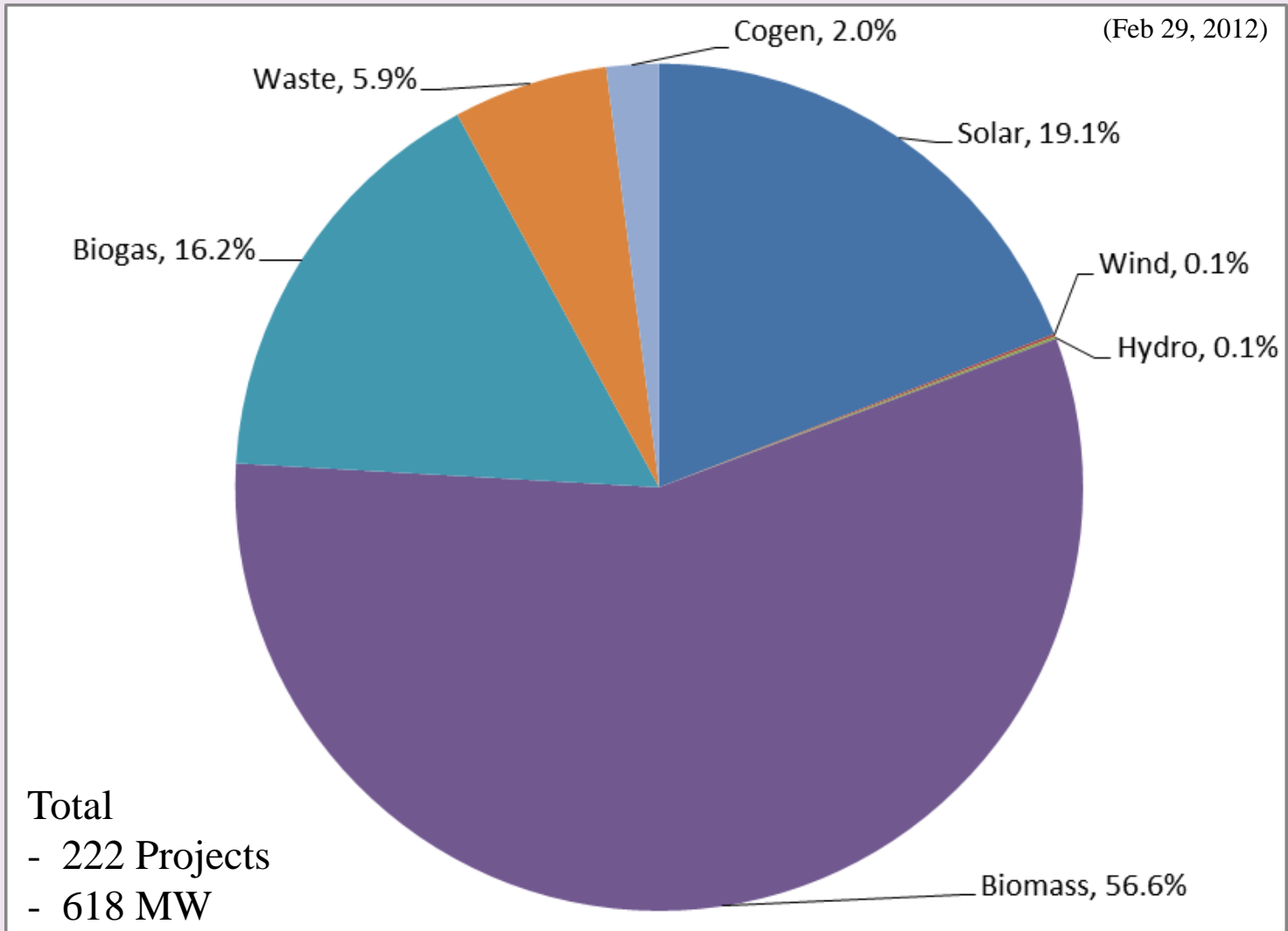
Total
665 Projects
3,358 MW

(29 Feb, 2012)



10. CO₂ Reduction Projects : SPP/VSPP

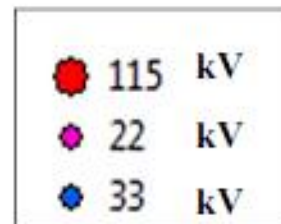
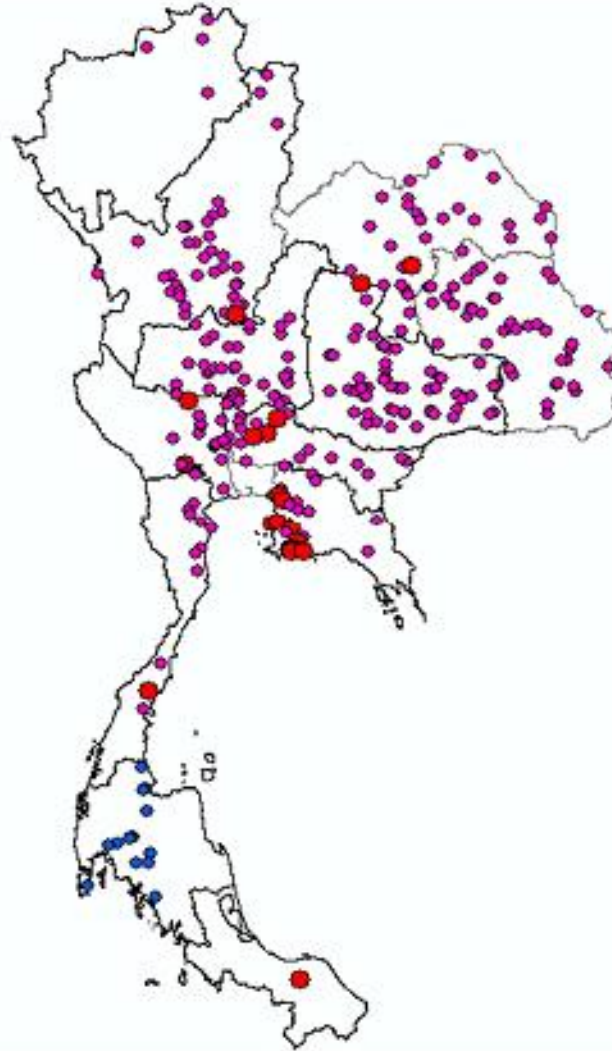
Supply To Grid





10. CO₂ Reduction Projects : SPP/VSPP

**The number of
SPP and VSPP
in Thailand**



Total : 222 Projects 618 MW



11. Status of AMR/ AMI in PEA

AMR/AMI Deployment

- Remote Metering has been in service to Commercial and Industrial consumers (MV & HV) with deploying the 1st-Stage AMR (Automatic Meter Reading) project since 2008 (35,940 consumers) and the 2nd-Stage AMR project since 2012-2013 (50,000 consumers) with GPRS
- Residential (LV) AMR Testing was started to pilot 200 households in Chonburi Province (100 households with Zigbee, 100 households with PLC) since 2010



11. Status of AMR/ AMI in PEA (cont')

- Nationwide Smart Meter will be completed by 2021 (18 M households)

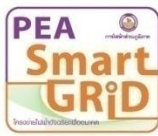
AMI (Advanced Metering Infrastructure) Program

- R&D : To build the prototype of Smart Meter and DCU (Data Concentrator Unit) from 2011-2012
- AMI pilot project in Pattaya city 110,000 consumers from 2012-2013



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12. PEA SG Roadman



**Foundation/
Pilot project**

**Large Scale
implementation**

Improvement

Phase 1 : 2012-2016-

Phase 2 : 2017-2021

Phase 3 : 2022-2026

**Smart
Energy**

Data Integration

Smart Asset Management

IT Security

DG Integration

Substation Automation

Source & Load Forecast

Smart Grid (4 cities)

Smart Grid (Large cities)

Smart Grid + Self-Healing

Micro smart grid/
Energy Storage

Micro Smart Grid, RE
and Energy Storage

Micro Smart Grid & large RE

Mobile Workforce (4 cities)

Mobile Workforce

Virtual Power Plant

**Smart
Life**

AMI (central region,
9 cities in others)

AMI

Prosumer & Real-time pricing

216 Smart & Green Office

Prosumer

Customer choice of selecting providers

Demand Response

Web-based Service

Advanced Demand Response

Demand Response

**Smart
comm**

Public Charging Station

Electric Vehicle

Smart Public Charging Station

Street Lighting/ Energy
Saving

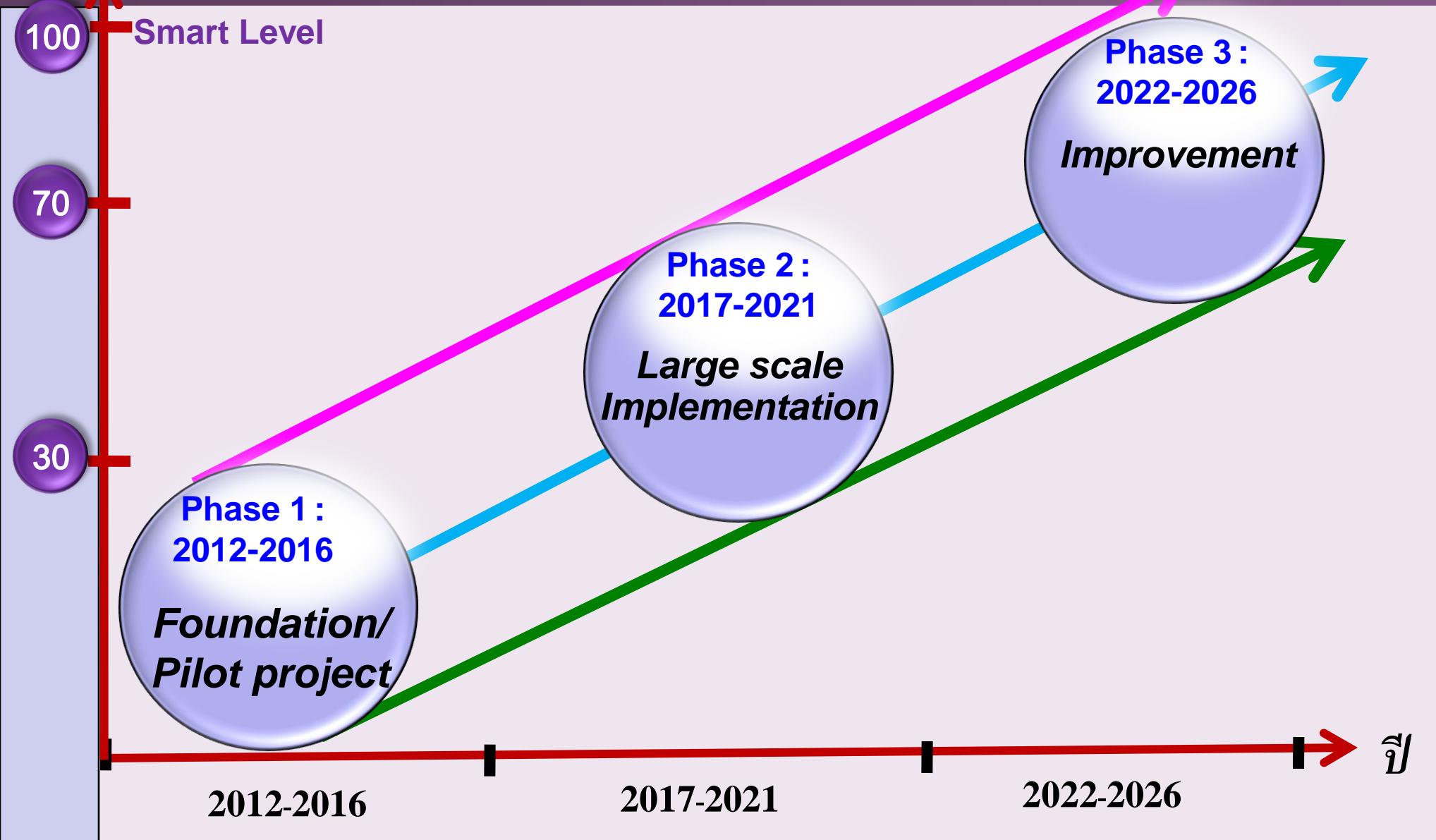
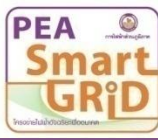
Community Street Lighting

Electric Vehicle To Grid

Auxiliary Service

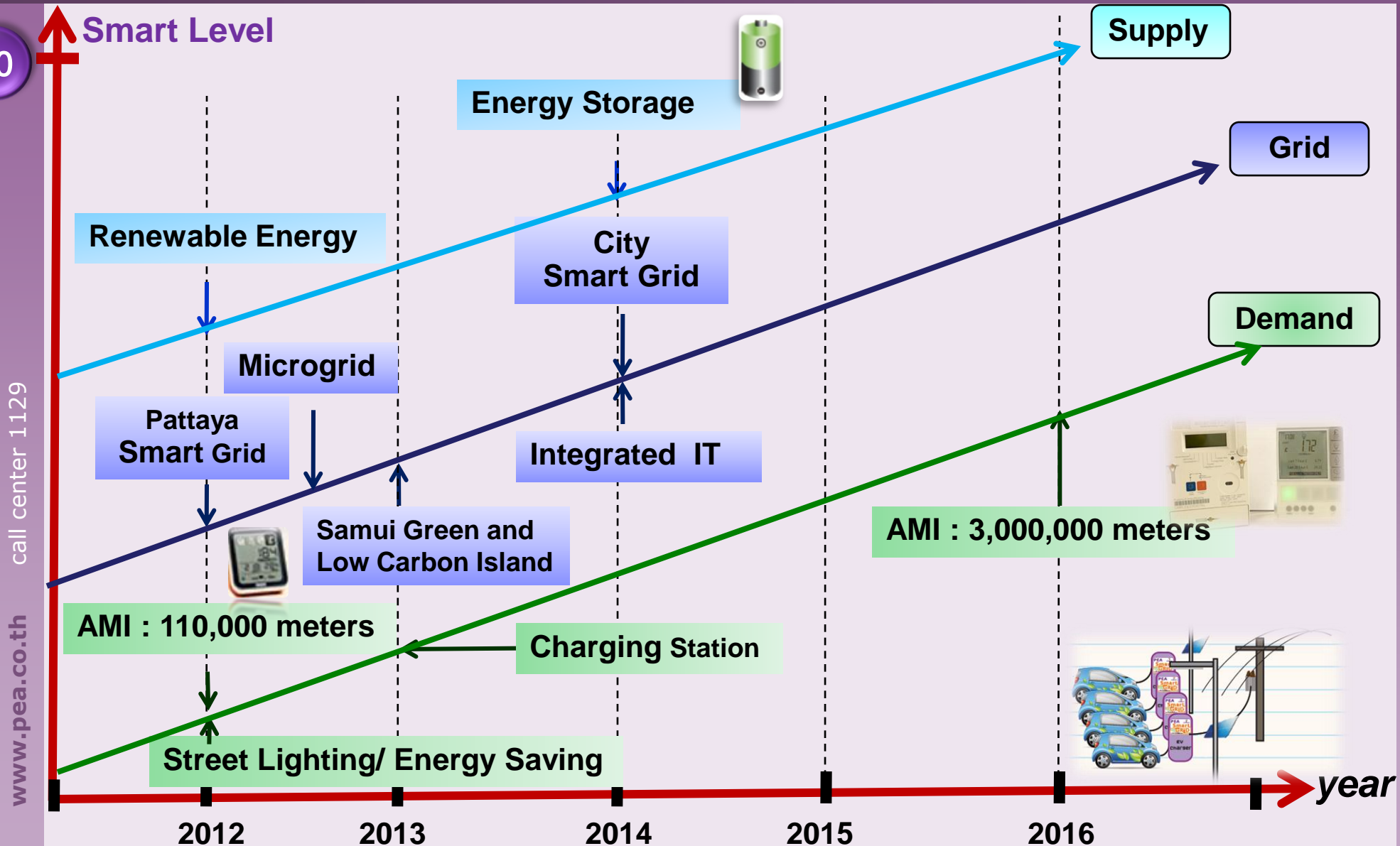
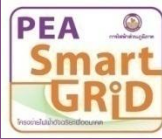


PEA SG Roadmap





Phase 1 : Foundation / Pilot Project

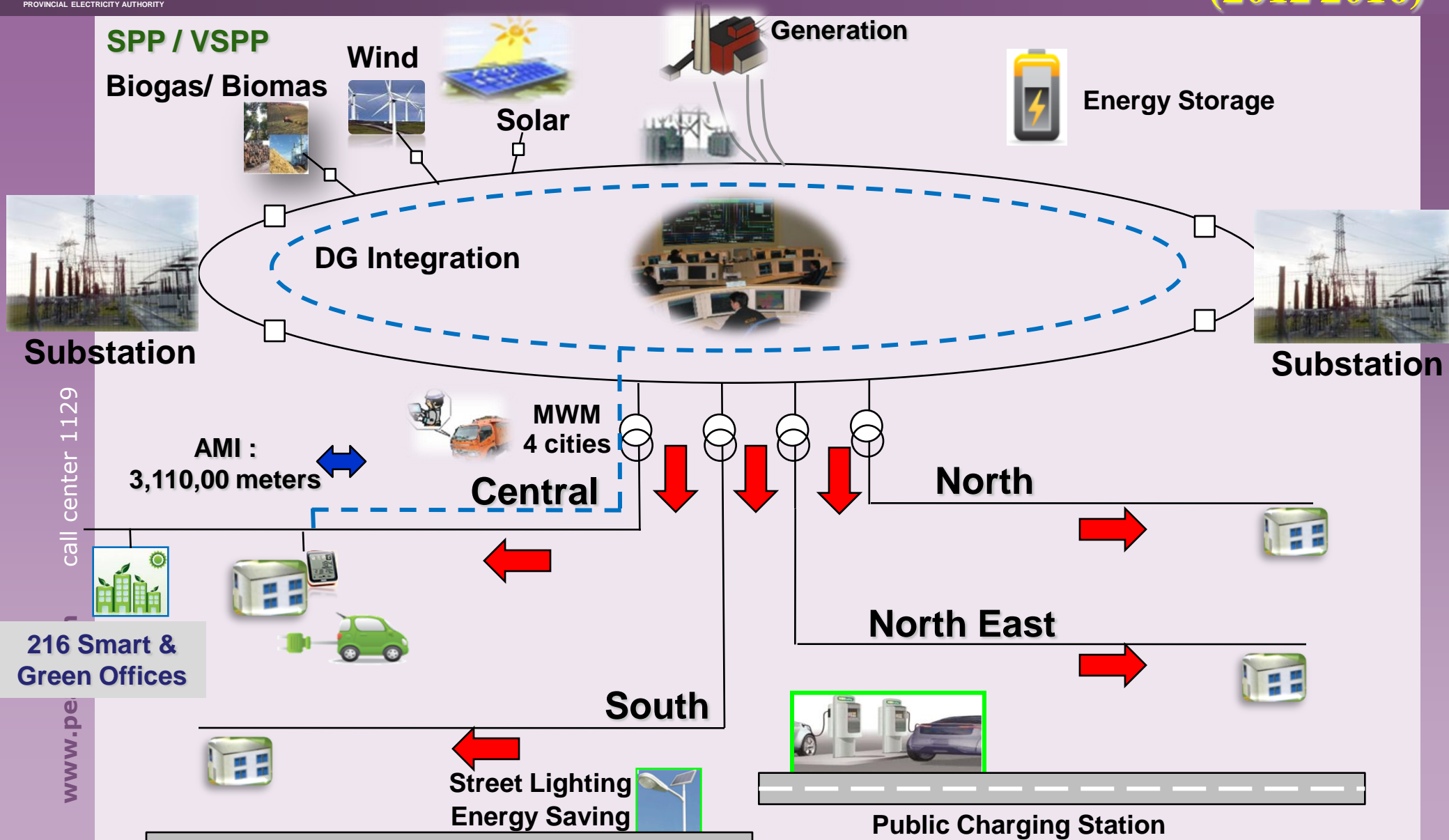




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Phase 1 : Foundation / Pilot Project

(2012-2016)



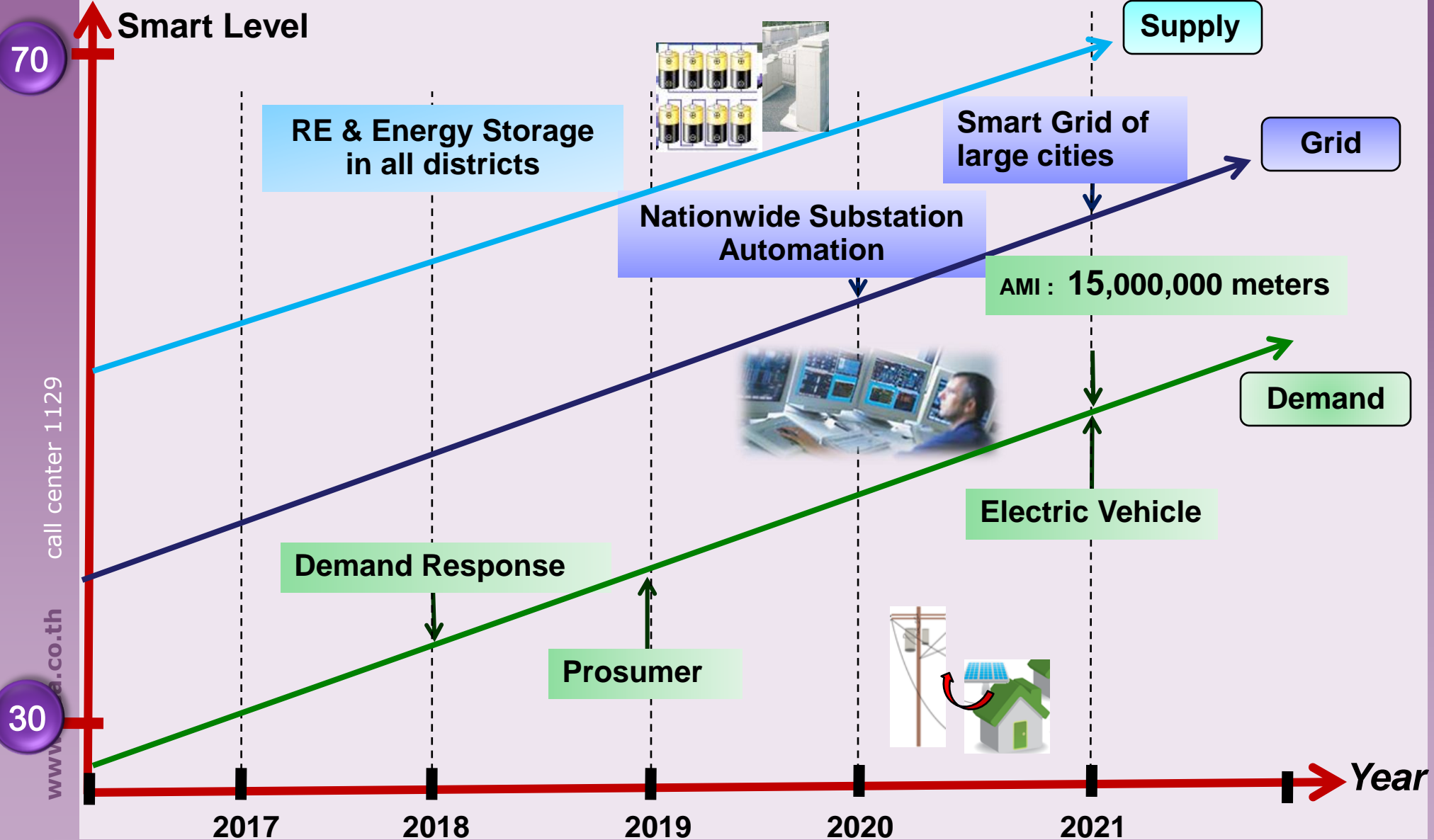
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216 Smart & Green Offices

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Phase 2 : Large Scale Implementation



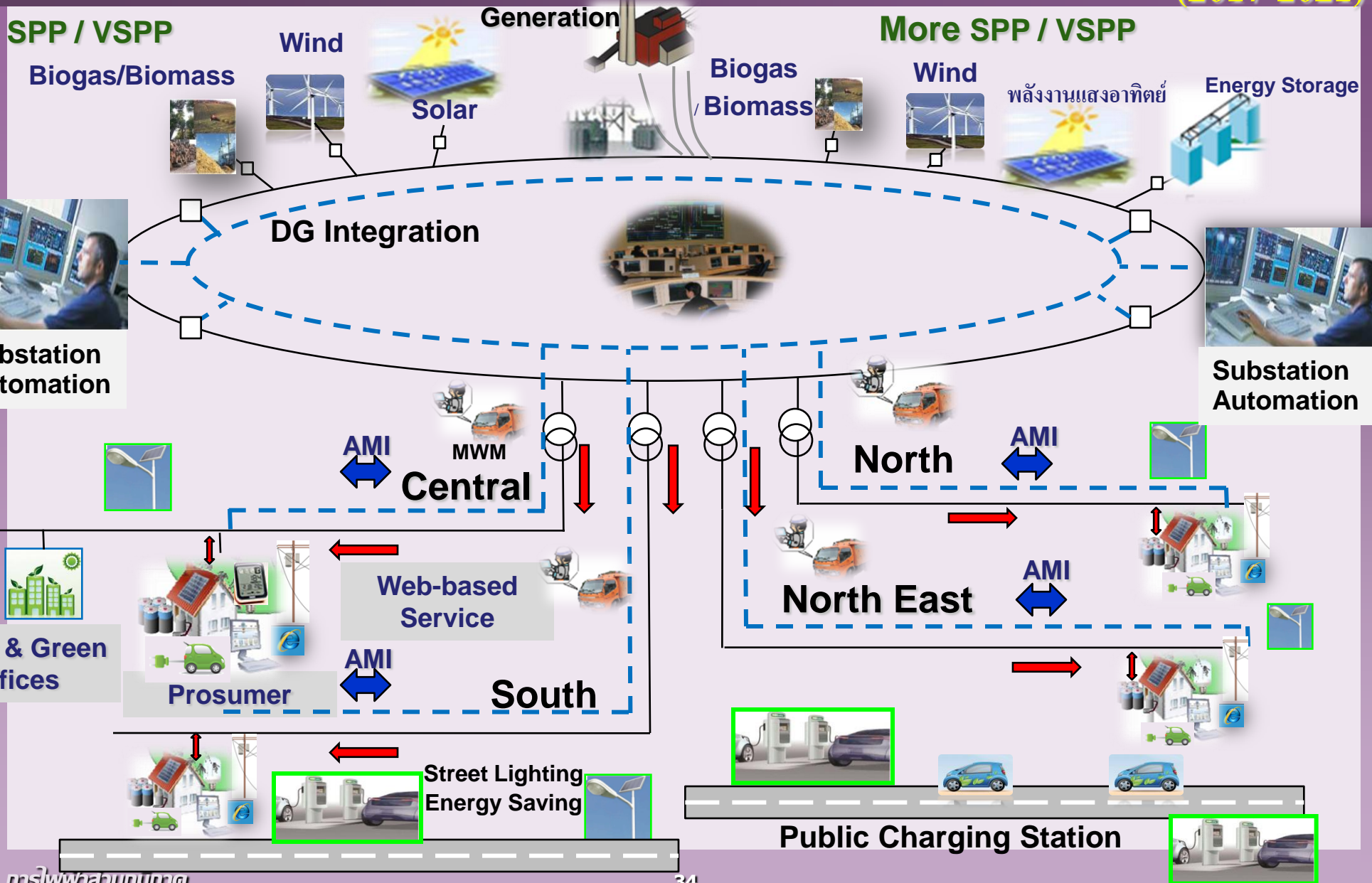
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Phase 2 : Large Scale Implementation

(2017-2021)

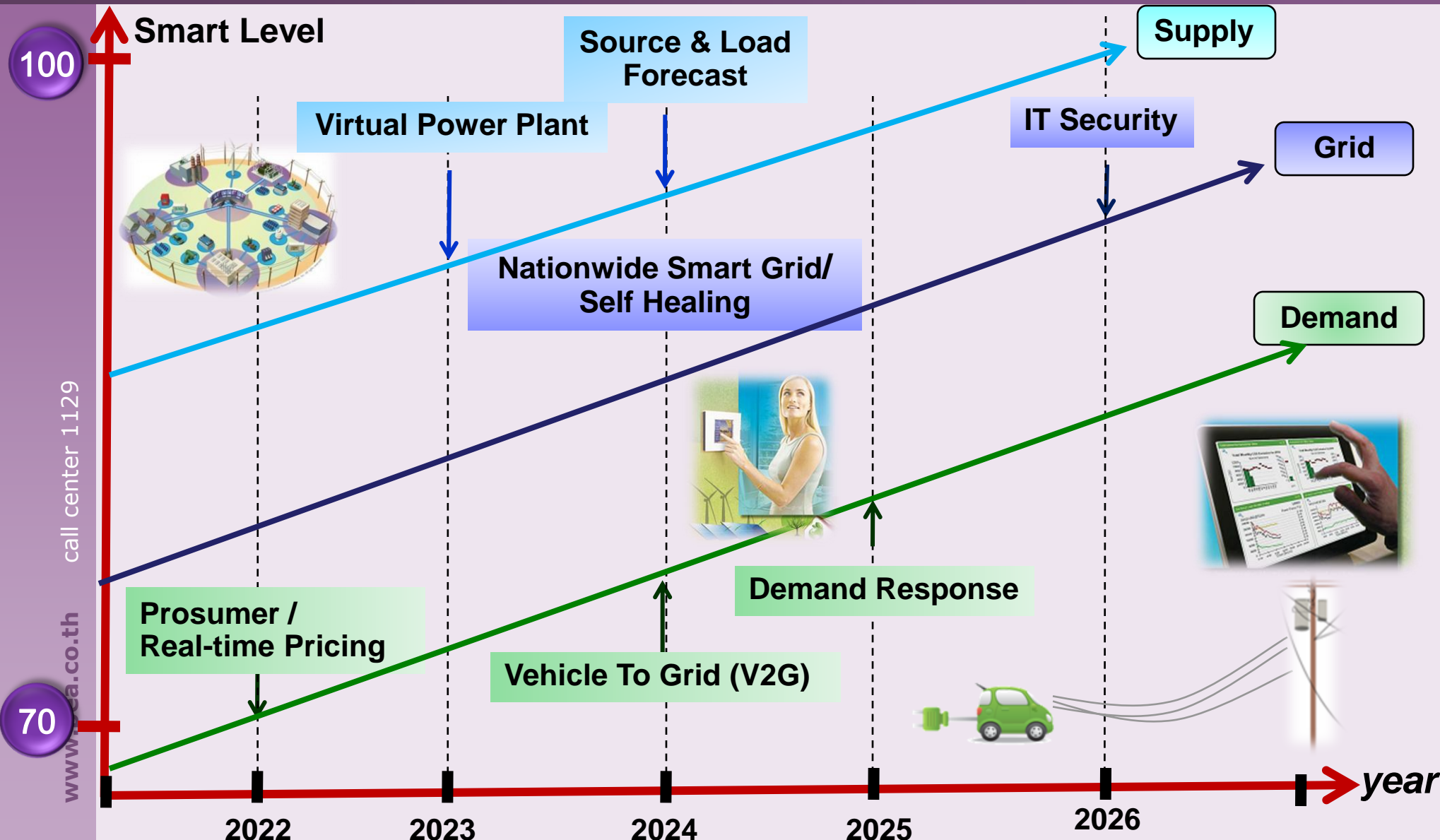


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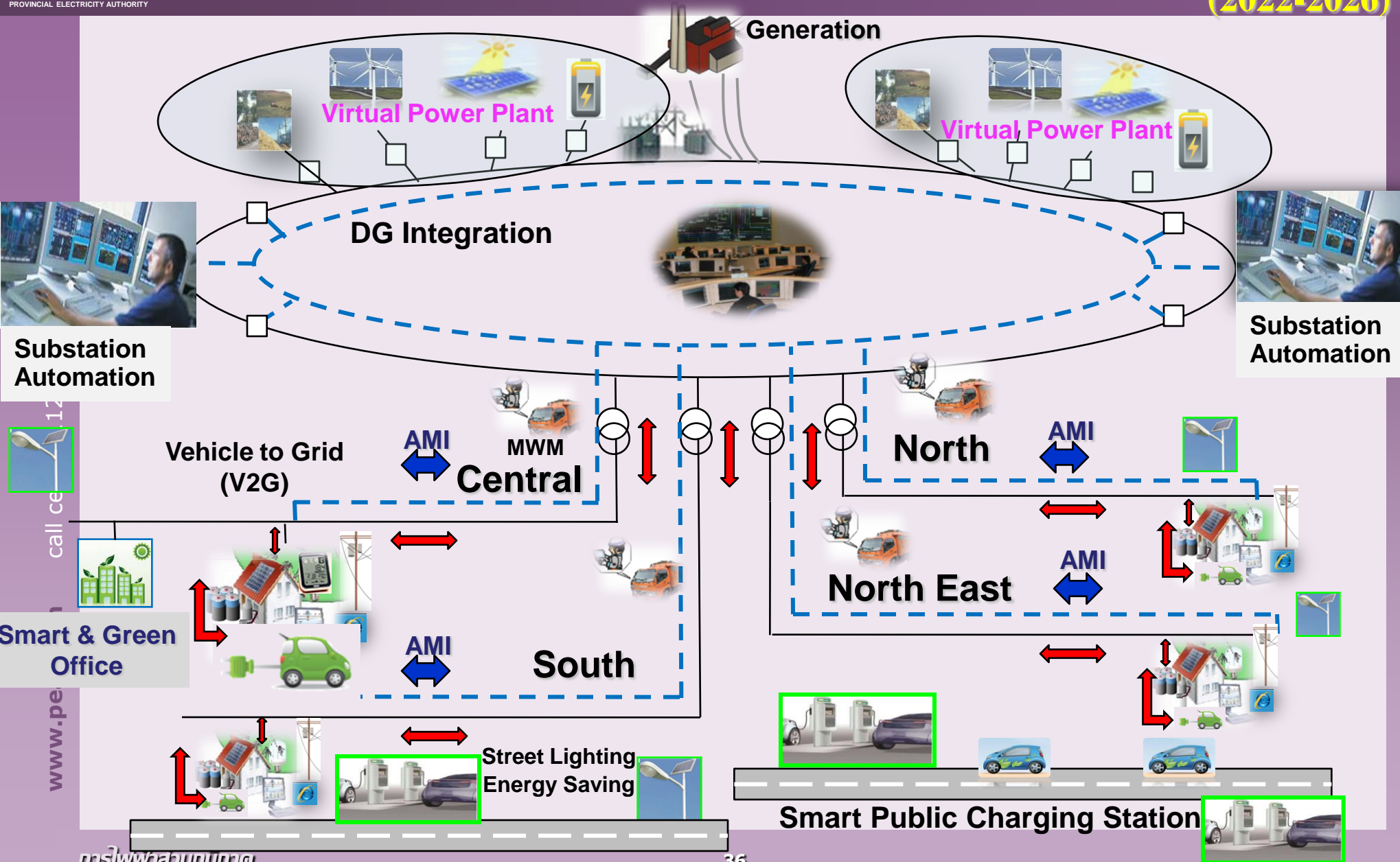
Phase 3 : Improvement





Phase 3 : Improvement

(2022-2026)



Substation Automation

Substation Automation

Vehicle to Grid (V2G)

Central

North

North East

South

Smart & Green Office

Street Lighting Energy Saving

Smart Public Charging Station

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13. Some PEA Smart Grid Investment Projects

Draft PEA Power System Development Plan
(under the 11th National Economic and Social Development Plan)

- Smart Grid Development Project : Phase I
- VSPP-Supported Power System Development Program
- Pattaya City Smart Grid Development Project
- AMI Development Project : Phase I



Draft PEA Power System Development Plan

(under the 11th NESDP)

Smart Grid Development Project : Phase I

Area: towns in 3 provinces

- Chiangmai
- Nakornratchasima
- Phuket

Budget : 77.1 M USD

(Exchange rate : 31 THB/USD)

Key Activities

- IEC61850 Substation Development
- FRTU Installation
- Mobile Workforce Establishment
- Rooftop PV Installation
- Energy Storage Installation
- Charging Station Installation
- Home Automation



Draft PEA Power System Development Plan

(under the 11th NESDP)

VSPP-Supported Power System Development Program

Area: a whole county

Budget : 87.7 M USD

(Exchange rate : 31 THB/USD)

Key Activities

- 22 kV and 33 kV Line Construction
- Installation of Load Break Switch with RCS
- Installation of AMI at VSPP
- FRTU Installation
- DCU-MDMS Communication System Installation



Draft PEA Power System Development Plan

(under the 11th NESDP)

Pattaya City Smart Grid Development Project

Area: Pattaya city,
Chonburi

Budget : 44.9 M USD

(Exchange rate : 31 THB/USD)

Key Activities

- Installation AMI – 118,636 units of 1 ϕ and 3 ϕ meters
- IEC61850 Substation Development
- FRTU Installation
- Mobile Workforce Establishment
- Rooftop PV Installation
- Energy Storage Installation
- Charging Station Installation
- Home Automation



Draft PEA Power System Development Plan

(under the 11th NESDP)

AMI Development Project : Phase I

Area:

- **10 Large cities**, including Chiangmai, Pitsanulok, Nakornratchasima, Nakornsawan, Khonkhaen, Ubonratthani, Huahin, Hatyai, Samui, Phuket
- All Central Area, excluding Pattaya

Budget : 817.7 M USD

(Exchange rate : 31 THB/USD)

Key Activities

- Installation AMI – 5,160,467 units of 1 ϕ and 3 ϕ meters
- **HQ Computer Installation**
- Fiber Optic Installation
- **Communication Installation**
- Optical Network Unit Installation



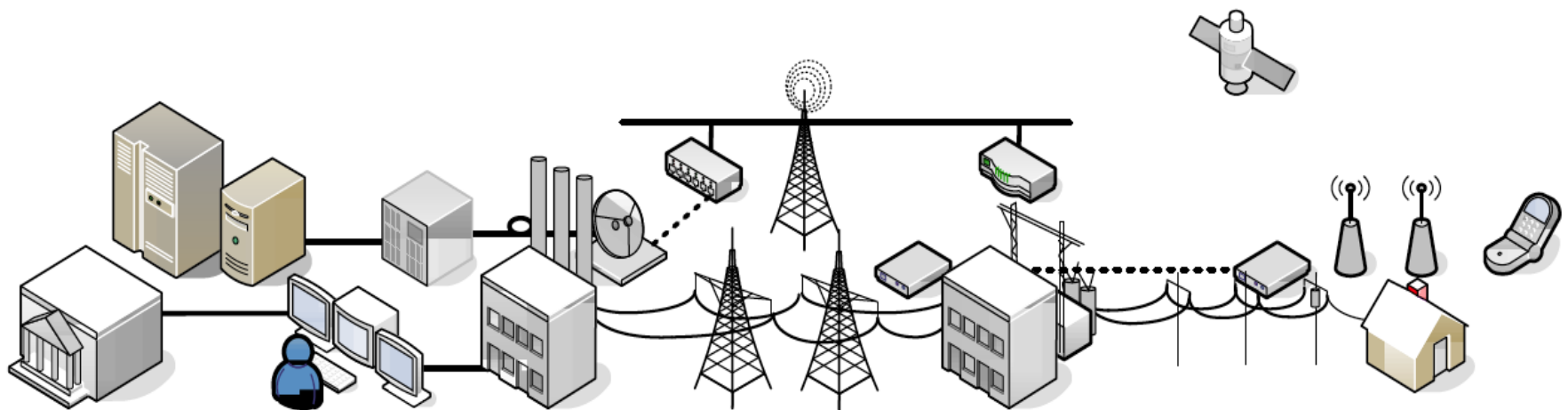
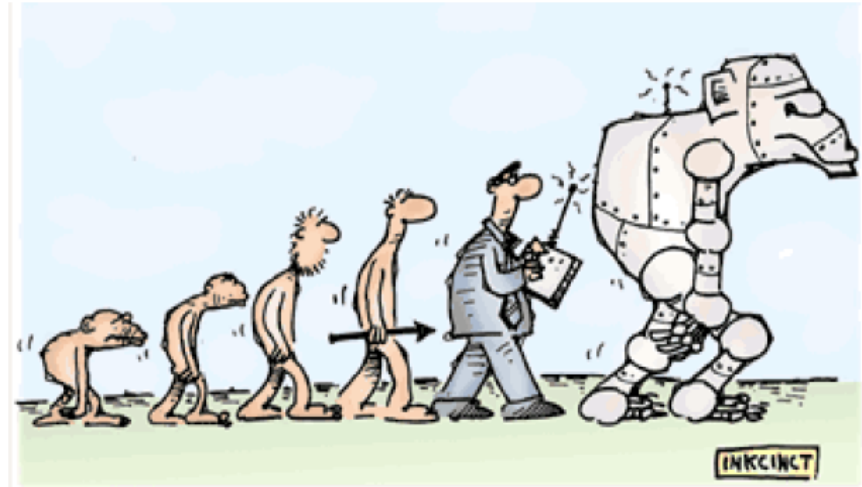
14. Benefits

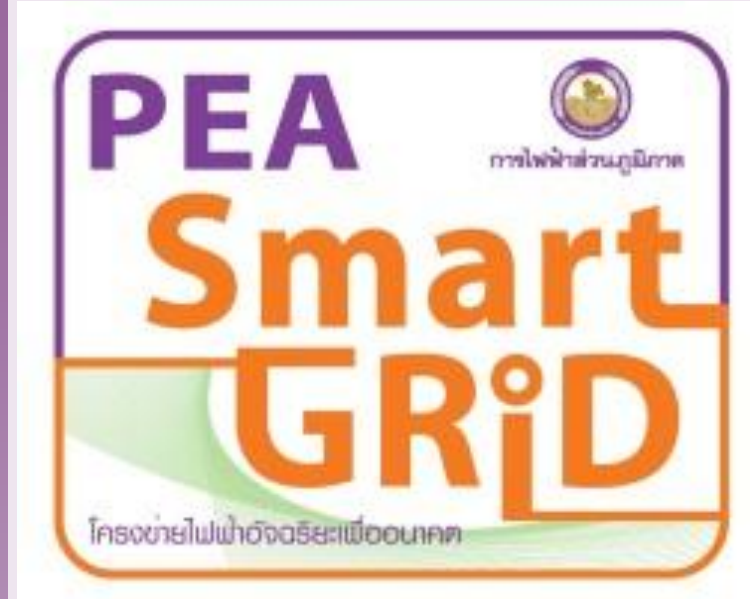
Item	Without Smart Grid	<i>With</i> Smart Grid
Renewable Energy	< 13%	>30%
Demand Response	5%	15%
Electricity generating by electricity users	<1%	10%
Asset utilization in generation	47%	90%
Asset utilization in transmission	50%	80%
Asset utilization in distribution	30%	80%



15. How is the Smart Grid Engineered

The smart grid is not created all at once – it will evolve over many years from today's infrastructure through the deployment and integration of *Intelligent Systems*





PEA SMART GRIDS

โลกพลังงานไฟฟ้าเพื่ออนาคต

การผลิตและใช้พลังงาน
อย่างชาญฉลาดและรู้คุณค่า
(พลังงานที่ฉลาด : **Smart Energy**)

เพื่อชีวิตที่สะดวกสบาย
(ชีวิตที่ฉลาด : **Smart Life**)

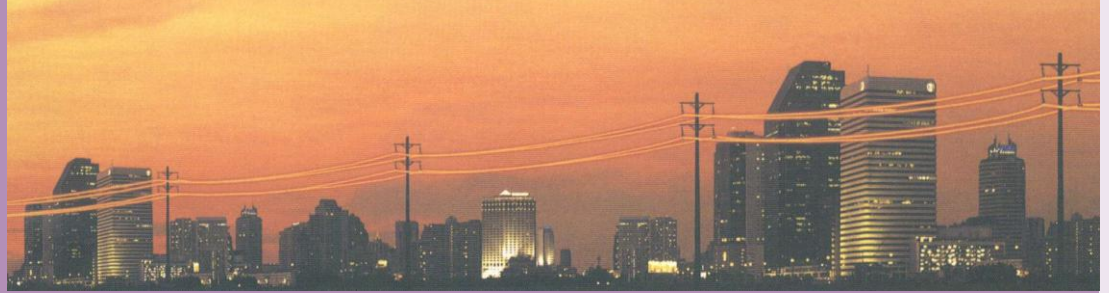
สู่สังคมและโลกที่น่าอยู่ในอนาคต
(สังคมที่ฉลาด : **Smart Community**)



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Thank you