Case study 1: Thailand Nanotechnology Roadmap

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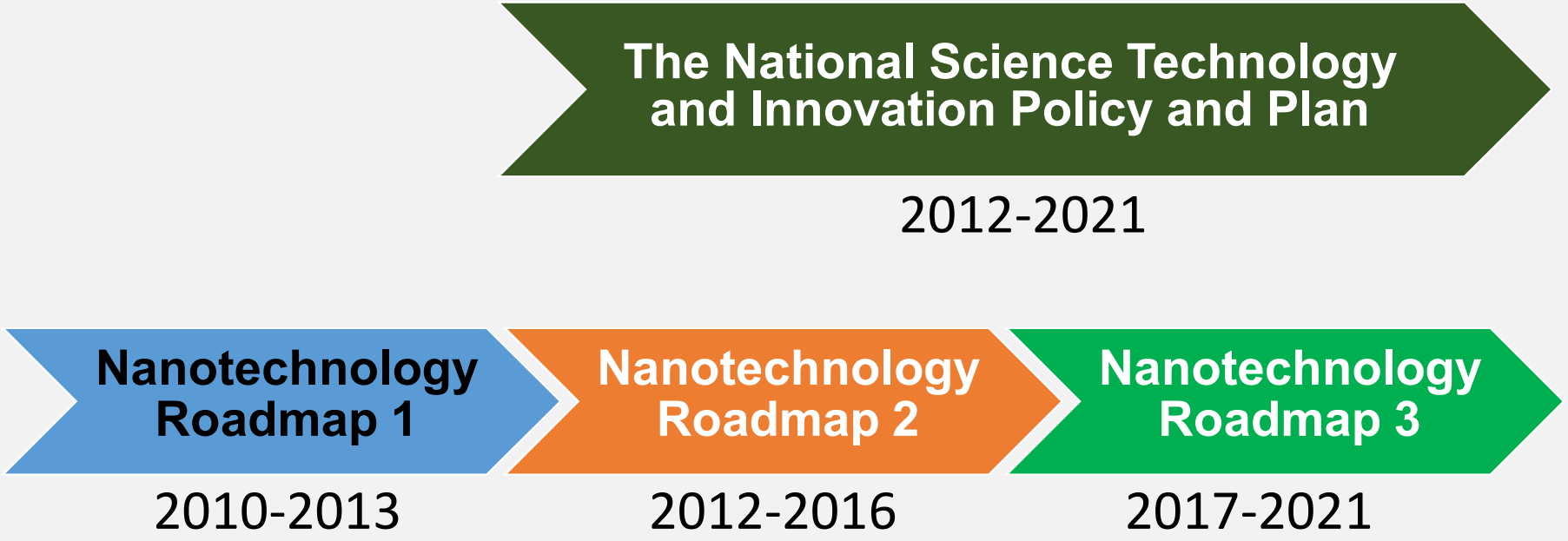
Technical Workshop for the Asia-Pacific Region on Nanotechnology and Manufactured Nanomaterials: Safety Issues

10th-11th of September 2015 at NSTDA, Sirindhorn Science Home, Bangkok, Thailand

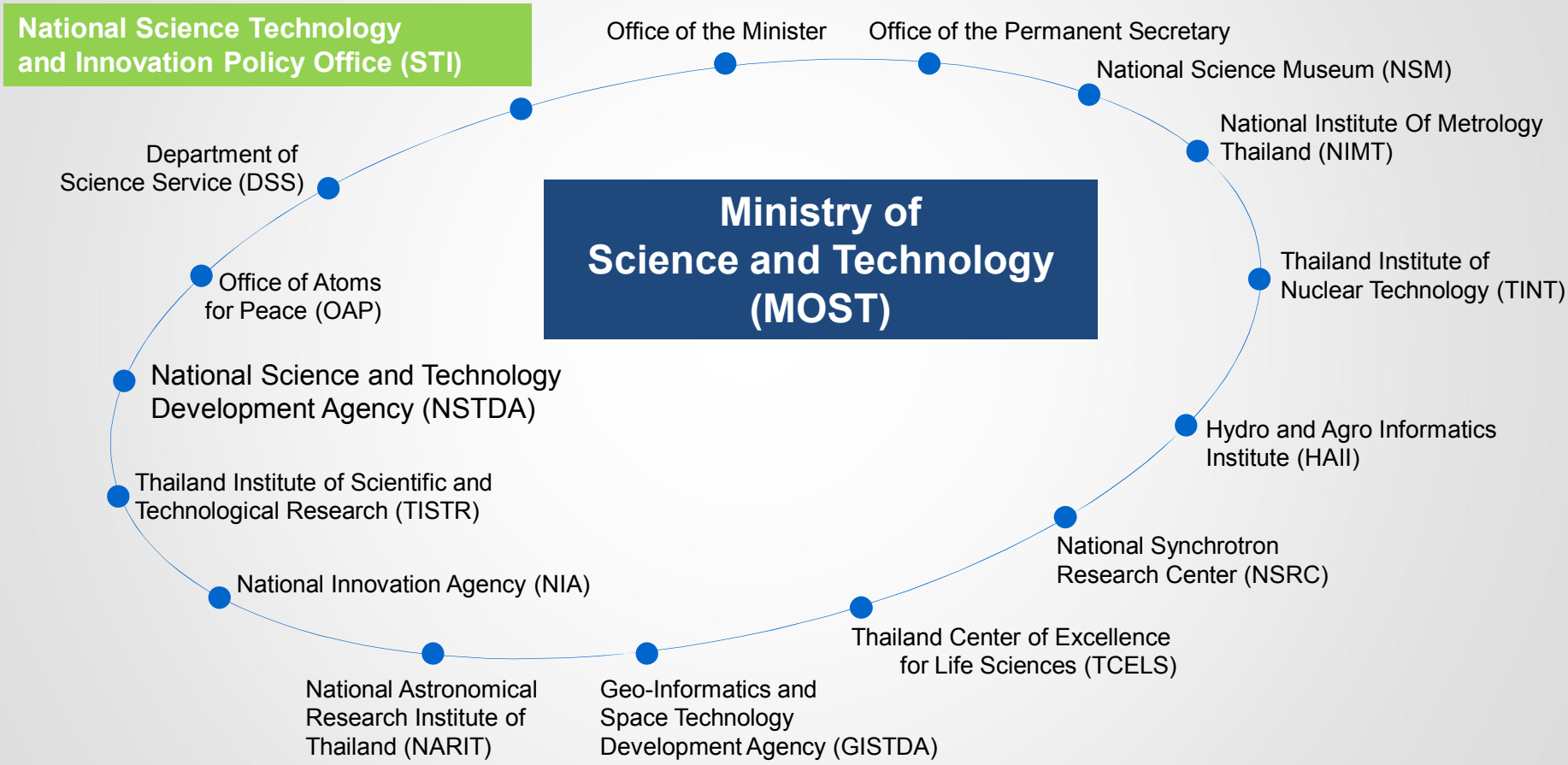
Outline

1. The Development of Nanotechnology Roadmap in Thailand
2. Nanotechnology Roadmap 2 (2012-2016) - (Current)
3. Nanotechnology Roadmap 3 (2017-2021) – (Preparing)

Nanotechnology Roadmap in Thailand



Agencies under Ministry of Science and Technology



STI's Major Responsibilities

1. To formulate the **national STI policies and plans**
2. To develop standard measurements, **indicators, database,** and conduct **policy research** on STI
3. To provide **support** and advice to other government agencies in formulating their own STI implementation plans
4. To coordinate and monitor the development of national S&T **manpower**
5. To **monitor, evaluate** and report the national STI implementation to the Committee and the Cabinet

The National Science Technology and Innovation Policy and Plan 2012 - 2021

- **First Time "INNOVATION" is systematically introduced**
- Address **STI for development** and **development of STI**

- Provide national direction for the next 10 years with periodic adjustments
- Identify Focuses and Balance between Economic and Social Development and Context for Thailand
- Preparedness for Future Changes that will have major impacts to Thai Society
- Plan derived from Intensive and Widespread Public & Stakeholders Participatory Process with Implementation Strategies Incorporated

Source: National Science Technology and Innovation Policy Office, Thailand

The National Science Technology and Innovation Policy and Plan 2012 - 2021

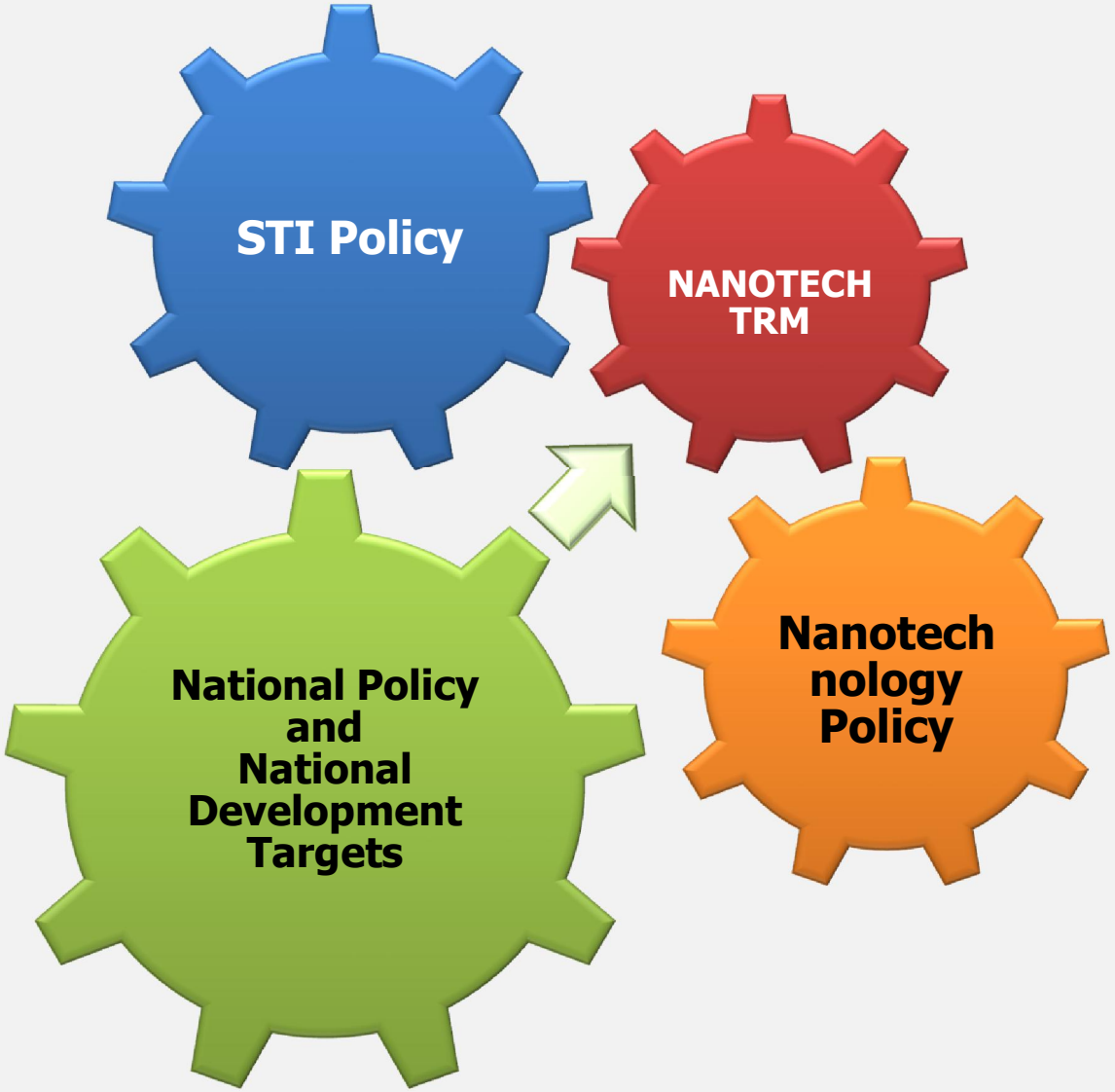
Green Innovation
for Quality Society and Sustainable Economic Growth

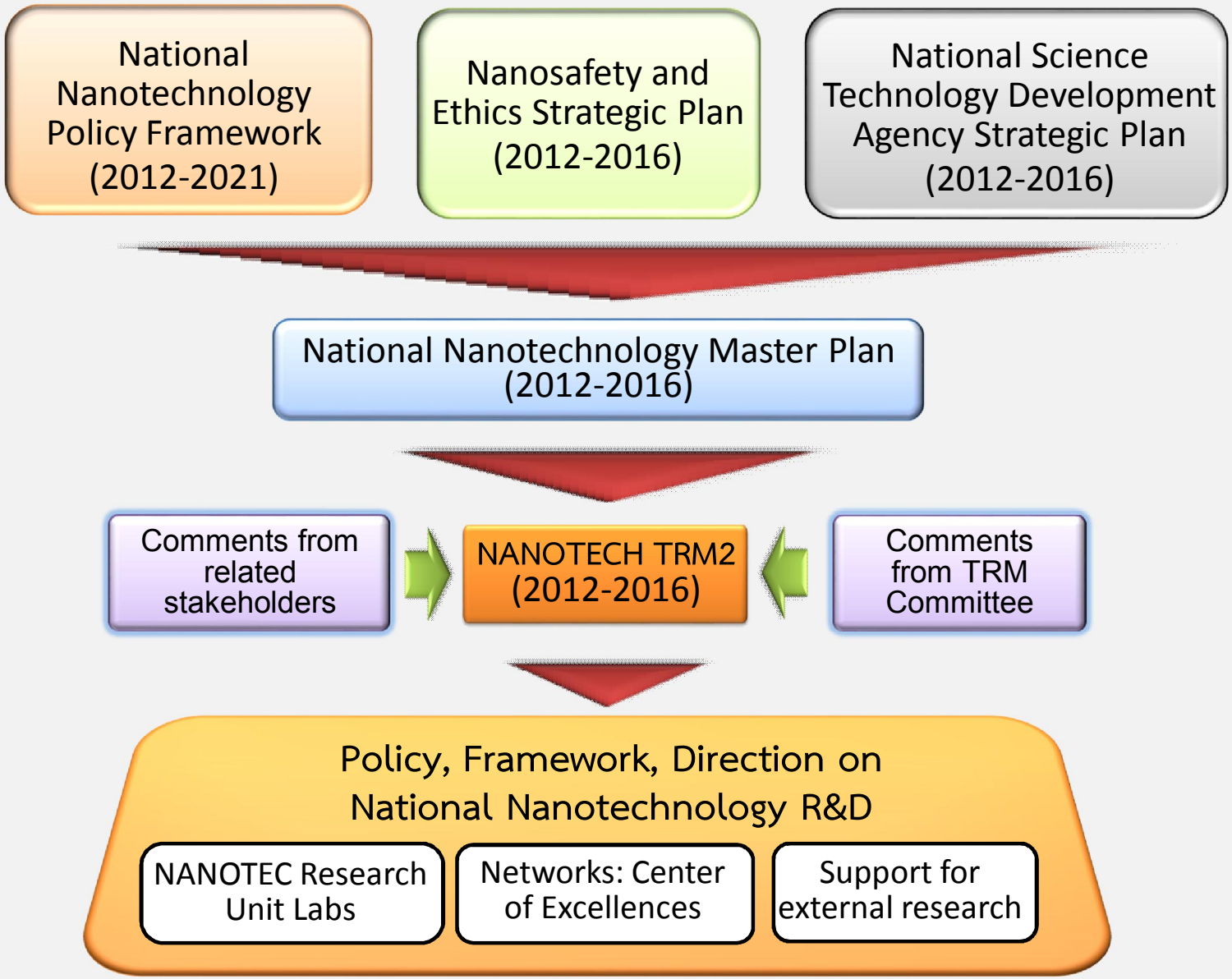
1. Empowering Society and Local Communities
2. Enhancing Economic Competitiveness and Flexibility
3. Ensuring Energy, Resource and Environment Security
4. Developing and Enhancing STI Human Capital
5. Promoting and Supporting the Development of STI Infrastructure and Enabling Factors

5 Strategic Action Agenda

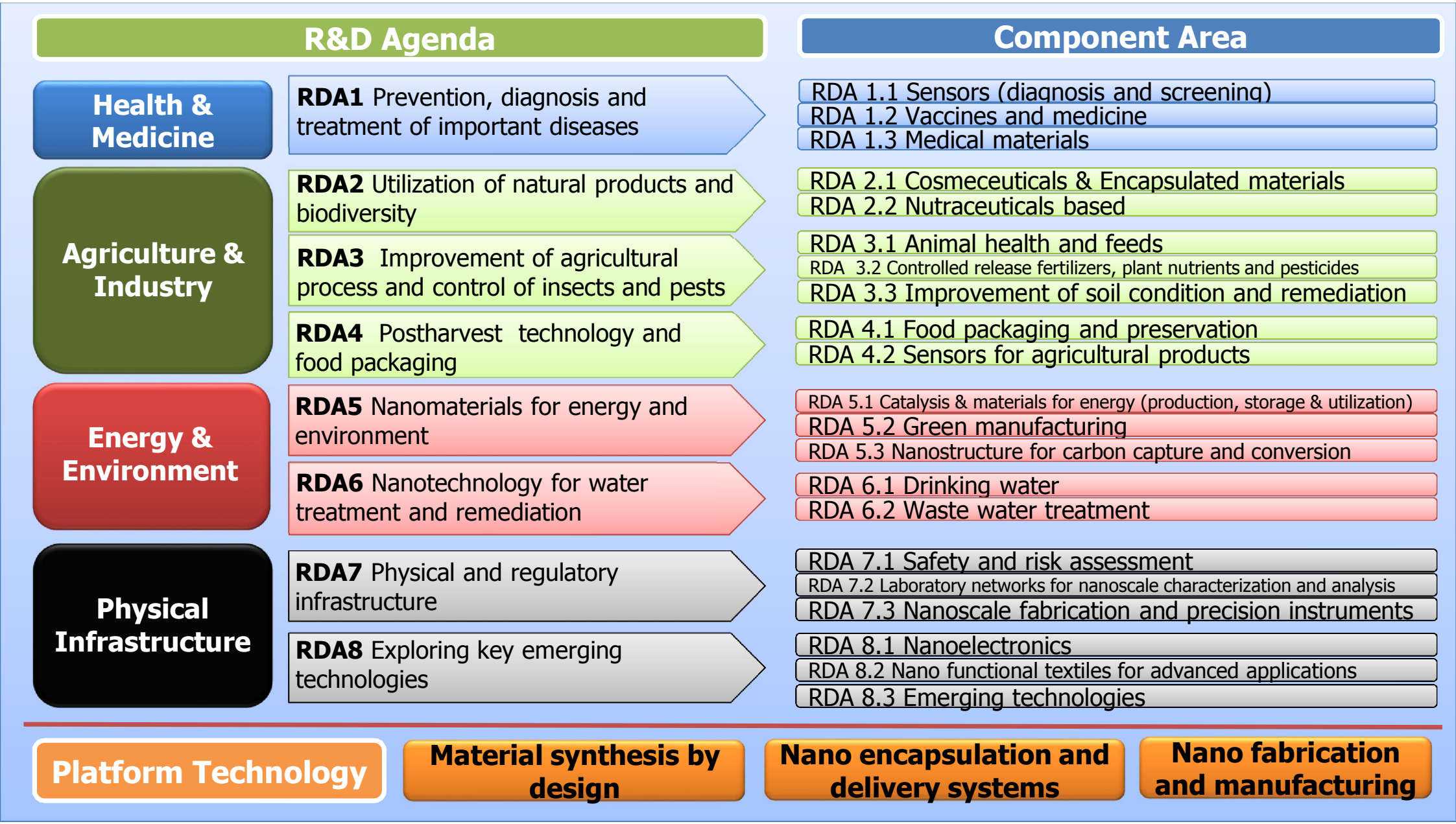
12 Target Economic Sectors

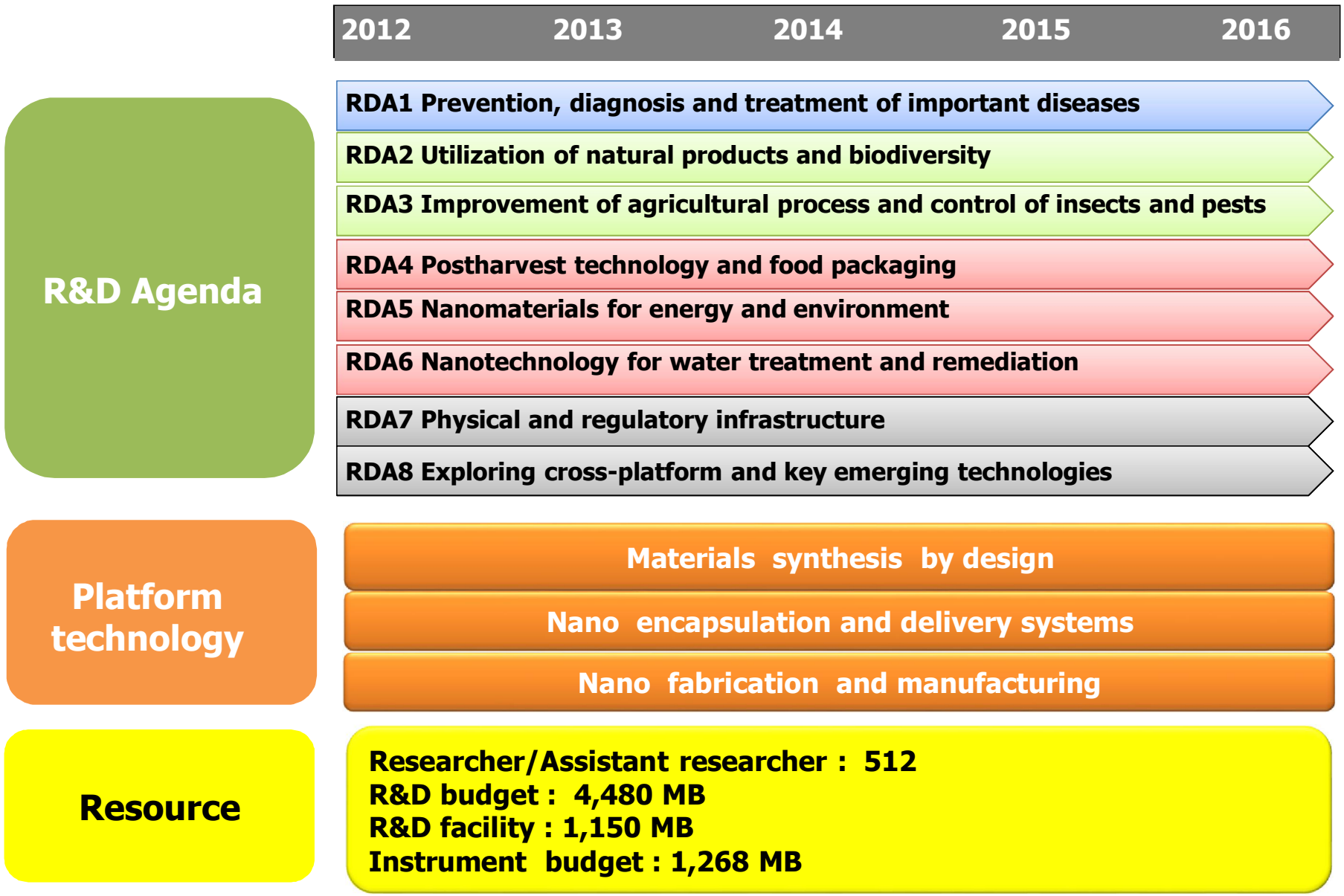
Source: National Science Technology and Innovation Policy Office, Thailand

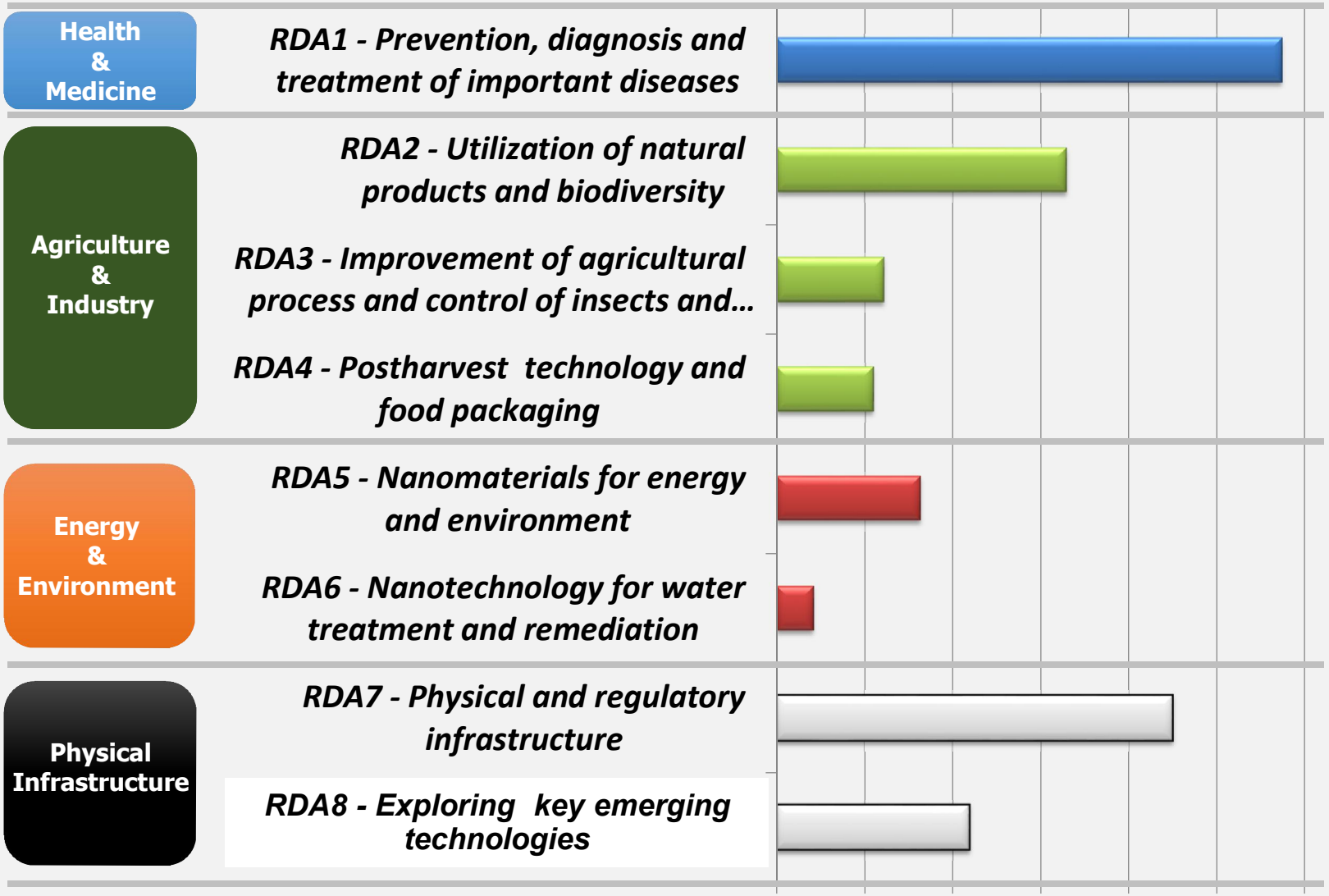

STI Policy
NANOTECH TRM
National Policy and National Development Targets
Nanotech nology Policy


National Nanotechnology Policy Framework (2012-2021)
Nanosafety and Ethics Strategic Plan (2012-2016)
National Science Technology Development Agency Strategic Plan (2012-2016)
National Nanotechnology Master Plan (2012-2016)
Comments from related stakeholders
NANOTECH TRM2 (2012-2016)
Comments from TRM Committee
Policy, Framework, Direction on National Nanotechnology R&D
NANOTEC Research Unit Labs
Networks: Center of Excellences
Support for external research

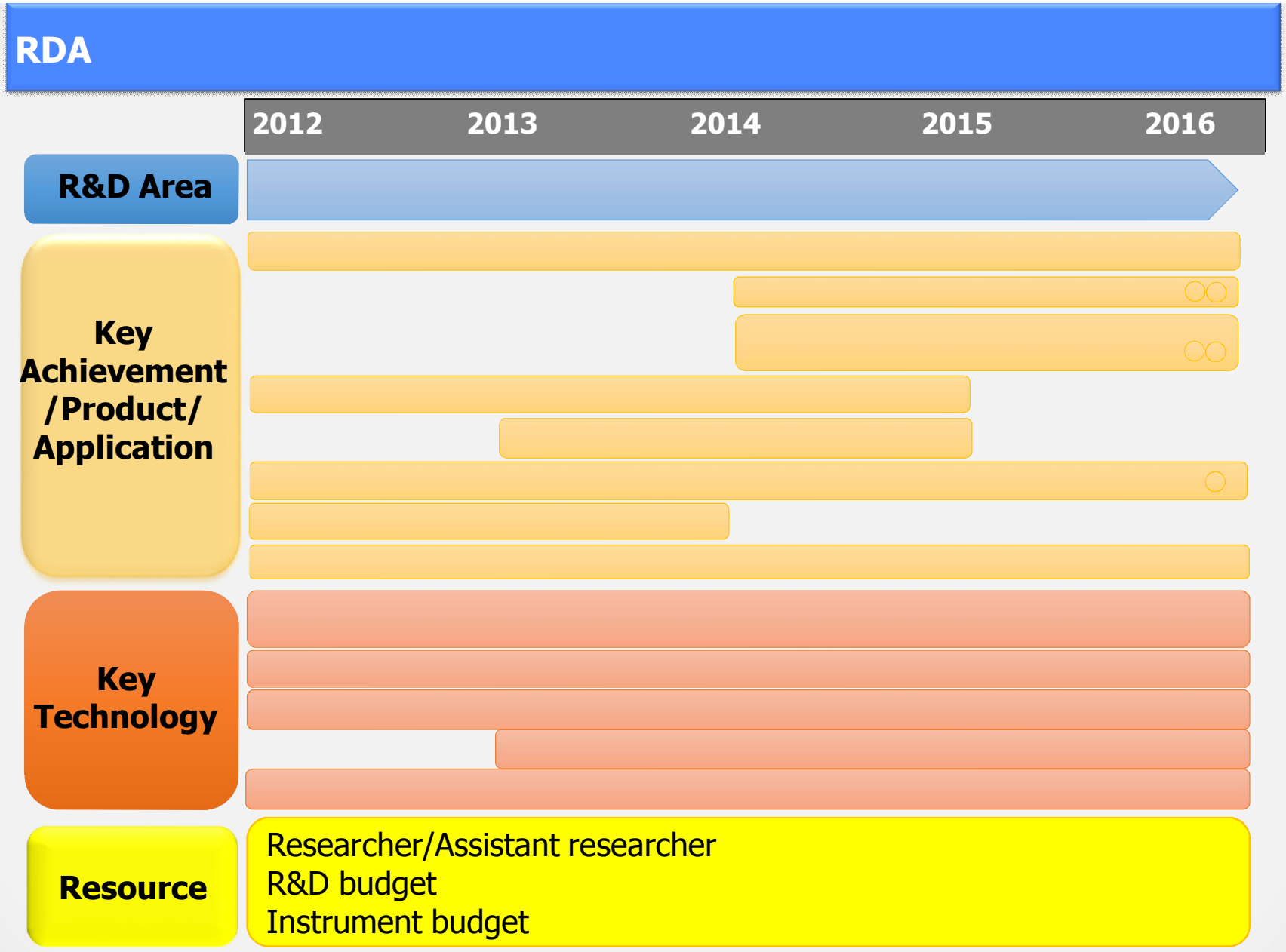
Nanotechnology Roadmap 2 (2012-2016)


R&D Agenda
Component Area
Health & Medicine
RDA1 Prevention, diagnosis and treatment of important diseases
RDA 1.1 Sensors (diagnosis and screening)
RDA 1.2 Vaccines and medicine
RDA 1.3 Medical materials
Agriculture & Industry
RDA2 Utilization of natural products and biodiversity
RDA 2.1 Cosmeceuticals & Encapsulated materials
RDA 2.2 Nutraceuticals based
RDA3 Improvement of agricultural process and control of insects and pests
RDA 3.1 Animal health and feeds
RDA 3.2 Controlled release fertilizers, plant nutrients and pesticides
RDA 3.3 Improvement of soil condition and remediation
RDA4 Postharvest technology and food packaging
RDA 4.1 Food packaging and preservation
RDA 4.2 Sensors for agricultural products
Energy & Environment
RDA5 Nanomaterials for energy and environment
RDA 5.1 Catalysis & materials for energy (production, storage & utilization)
RDA 5.2 Green manufacturing
RDA 5.3 Nanostructure for carbon capture and conversion
RDA6 Nanotechnology for water treatment and remediation
RDA 6.1 Drinking water
RDA 6.2 Waste water treatment
Physical Infrastructure
RDA7 Physical and regulatory infrastructure
RDA 7.1 Safety and risk assessment
RDA 7.2 Laboratory networks for nanoscale characterization and analysis
RDA 7.3 Nanoscale fabrication and precision instruments
RDA8 Exploring key emerging technologies
RDA 8.1 Nanoelectronics
RDA 8.2 Nano functional textiles for advanced applications
RDA 8.3 Emerging technologies
Platform Technology
Material synthesis by design
Nano encapsulation and delivery systems
Nano fabrication and manufacturing


2012
2013
2014
2015
2016
R&D Agenda
RDA1 Prevention, diagnosis and treatment of important diseases
RDA2 Utilization of natural products and biodiversity
RDA3 Improvement of agricultural process and control of insects and pests
RDA4 Postharvest technology and food packaging
RDA5 Nanomaterials for energy and environment
RDA6 Nanotechnology for water treatment and remediation
RDA7 Physical and regulatory infrastructure
RDA8 Exploring cross-platform and key emerging technologies
Platform technology
Materials synthesis by design
Nano encapsulation and delivery systems
Nano fabrication and manufacturing
Resource
Researcher/Assistant researcher : 512
R&D budget : 4,480 MB
R&D facility : 1,150 MB
Instrument budget : 1,268 MB



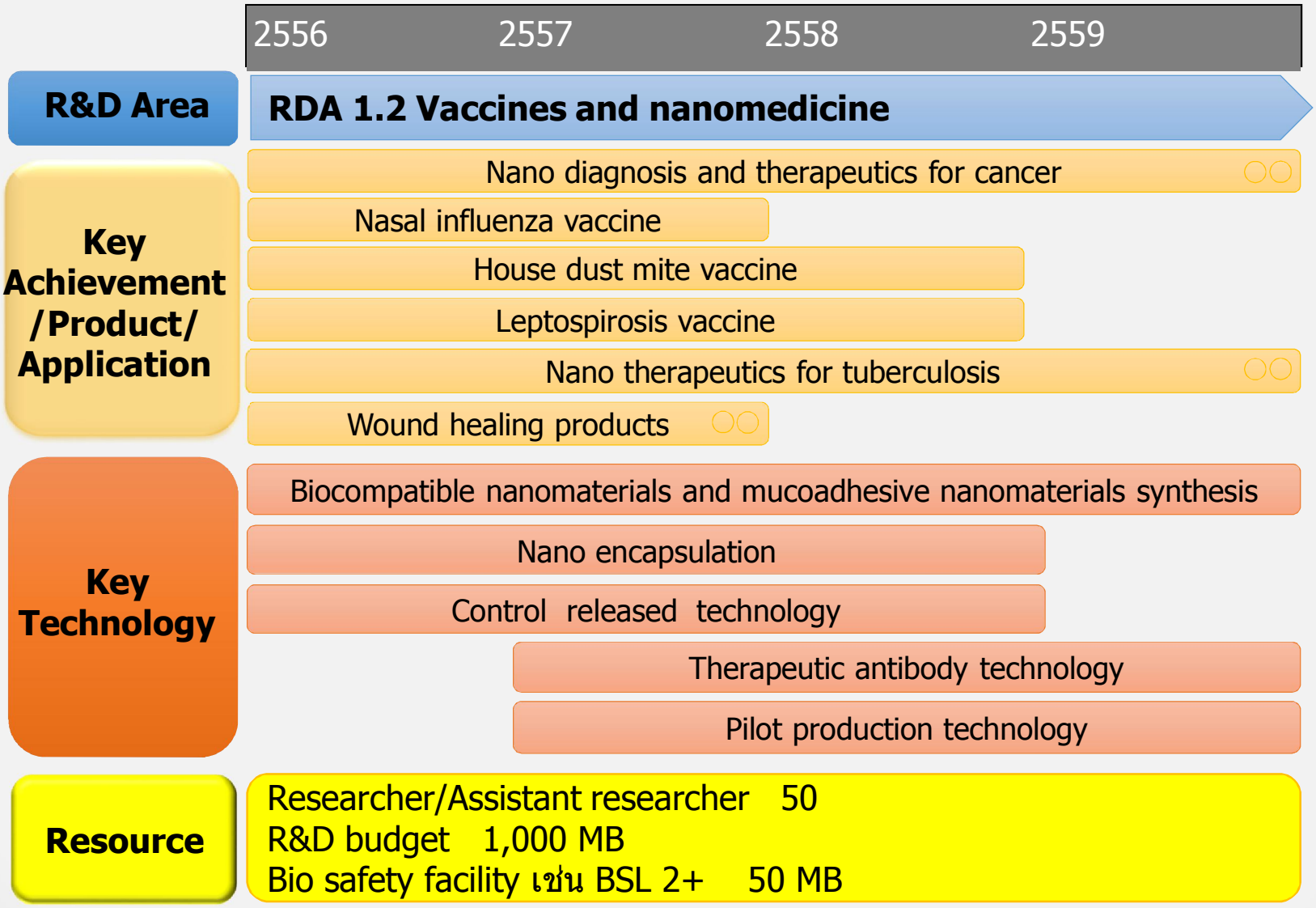
Total budget : 6,900 MB


RDA
2012
2013
2014
2015
2016
R&D Area
Key Achievement /Product/ Application
Key Technology
Resource
Researcher/Assistant researcher
R&D budget
Instrument budget

RDA1 Prevention, diagnosis and treatment of important diseases

	2556	2557	2558	2559
R&D Area	**RDA 1.1 Nanosensors for diagnosis and screening**			
Key Achievement /Product/ Application	Cervical cancer screening kit			
			Bioelectronic nose; Bio e-nose	
			Antibody targeted molecular imaging for cancer	
	Nucleic acid detection by LFA			
		Glycated albumin test		
	High-throughput blood group detection system			
	Leptospirosis kit			
	Economic animal diseases detection			
Key Technology	Optical, Electrical, Electrochemical, Magnetic and piezoelectric detections and integrated system			
	Microfluidic technology			
	Lateral flow assay technology			
		Cell/Target enrichment by nanotechnology		
	Nanostructure fabrication and surface modification			
Resource	Researcher/Assistant researcher 33 R&D budget 400 MB Instrument budget 100 MB			

RDA1 Prevention, diagnosis and treatment of important diseases



Nanotechnology Roadmap 3 (2017-2021)

Criteria Set

Importance			Feasibility
Economic Importance	**Social Importance**	**Environmental Importance**	
Impact on economic growth	Impact/influence on the quality of life (safety/security)	Impact on reduction of pollution, protection from pollution, and evaluation of impact from pollution	Probability of technology implementation
Impact on productivity	Influence on the creation of job opportunities	Impact on access and utilization of natural resource and waste management	Support in the administration/state policy and regulation (soft infrastructure)
Influence on the creation and growth potential of SMEs	Reduce social inequality	Effect on Climate Change (adaptation and mitigation)	Social Acceptance
Economic sustainability	Importance for learning society		Supports of financing (Financial resource)
National Competitiveness			Availability of human capital e.g. education, quality, etc.
Economic Transformation			Probability of involvement in international collaboration (Supply Chain R&D collaboration (Domestic/Intl))
			R&D infrastructure (hard infrastructure)

Component Area	Importance	Feasibility (+)	Feasibility (-)
7.1 Nanosafety & risk assessment	4.14	3.88	3
5.1 Nanocatalysis & nanomaterials for energy production, storage and utilization	4.1	4.38	3.71
1.1 Nanosensors for diagnosis & screening	4.08	3.63	3.28
7.2 National laboratory network for nanoscale characterization & analysis	4.04	3.95	3.19
7.3 Nanoscale fabrication and characterization facilities	4.02	3.67	3.42
4.1 Nanomaterials for food packaging & preservation	3.97	3.83	3.17
5.2 Green manufacturing technology	3.97	3.73	3.29
4.2 Nanosensors for agricultural products	3.93	3.69	3.22
2.1 Nanocosmeceuticals & encapsulated Thai herbal active ingredients	3.92	3.88	2.83
2.3 Nanotechnology for animal health & feeds	3.88	3.48	2.83
6.1 Nanotechnology for drinking water	3.87	3.84	3.25
8.3 Emerging technologies	3.87	3.66	3.1
8.1 Nanoelectronics	3.85	3.81	3.4
5.3 Nanostructure for carbon capture and conversion	3.81	3.73	3.25
6.2 Nanotechnology for waste water treatment	3.81	3.59	3.13
8.2 Nano functional textiles for advanced applications	3.79	3.92	2.71
1.3 Medical materials	3.74	3.43	3.67
1.2 Vaccines & nanomedicine	3.68	3.5	3.61
3.1 Controlled release fertilizers, plant nutrients, pesticides	3.66	3.63	2.72
2.2 Nutraceuticals based on nanotechnology	3.57	3.48	3.06
3.2 Improvement of soil condition and remediation	3.57	3.62	2.94

Expert Panels:

National Key Technology

(Biotechnology, Nanotechnology, ICT, Material Technology)

19-20 June, 2015, Sampran, Nakhorn-Prathom, Thailand (Hosted by STI and NSTDA)

Key Technology Workshop
→ Top 10 Nanotechnology

1. Responsive Nanomaterials for smart tag	6. NanoCatalyst for new storage, renewable energy, production, and CO2-to-fuel
2. NanoSensor for food safety and food quality	7. NanoDelivery system for cosmetics/Disease (targeting) and therapy/vaccine
3. NanoMembrane for Packaging	8. NanoSensor for diagnostic KHS
4. NanoDelivery system for nutrient, nutraceutical and functional food	9. Responsive Nanomaterials for self-cleaning/anti-microbials
5. NanoMembrane for desaltination	10. NanoFertilizer for productive enhancement

Component Area	CUT		
1.1 Nanosensors for diagnosis & screening	1	5.4 NanoSensor for enivironmental mornitoring	4.06
1.2 Vaccines & nanomedicine	6	9.2 NanoSensor for safety device	3.99
1.3 Medical materials & nanomedicine	2	9.1 Carbon Nanomaterials for reinforcement technology	3.88
2.1 Nanocosmeceuticals & encapsulated Thai herbal active ingredients	3	10.3 Photo Nanomaterials for self-cleaning/anti-microbials	3.78
2.2 Nutraceuticals based on nanotechnology	7	10.2 Nanocomposite for light weight/sound absorbance/insulator	3.76
2.3 Nanotechnology for animal health & feeds	1	10.4 Electrospinning process for nanofiber production	3.68
3.1 Controlled release fertilizers, plant nutrients, pesticides	4	10.5 Nanogranulation/Ball-milling process for Nanomaterial	3.68
3.2 Improvement of soil condition and remediation	8	1.4 NanoActuator for robotics/automation	3.6
4.1 Nanomaterials for food packaging & preservation	1	10.1 NanoComputing for Big data analysis	3.6
4.2 Nanosensors for agricultural products	1	10.6 Self-assembly	3.41
5.1 Nanocatalysis & nanomaterials for energy production, storage and utilization			
5.2 Green manufacturing technology	5		
5.3 Nanostructure for carbon capture and conversion	3		
6.1 Nanotechnology for drinking water	1		
6.2 Nanotechnology for air/waste water treatment and monitoring	1		
7.1 Nanosafety & risk assessment	1		
7.2 National laboratory network for nanoscale characterization & analysis	4		
7.3 Nanoscale fabrication and characterization facilities	1		
8.1 Nanoelectronics (Nanosensor เพิ่มเนื้อหาหมวดรถยนต์)	2		
8.2 Nano functional textiles for advanced applications	2		
8.3 Emerging technologies (ตัวเนื้อหาให้คำนึงถึง 9.1, 10.2 ด้วย)	2		

Thank you very much for your attention!