Smart Grid Roadmap...
the Development Experience

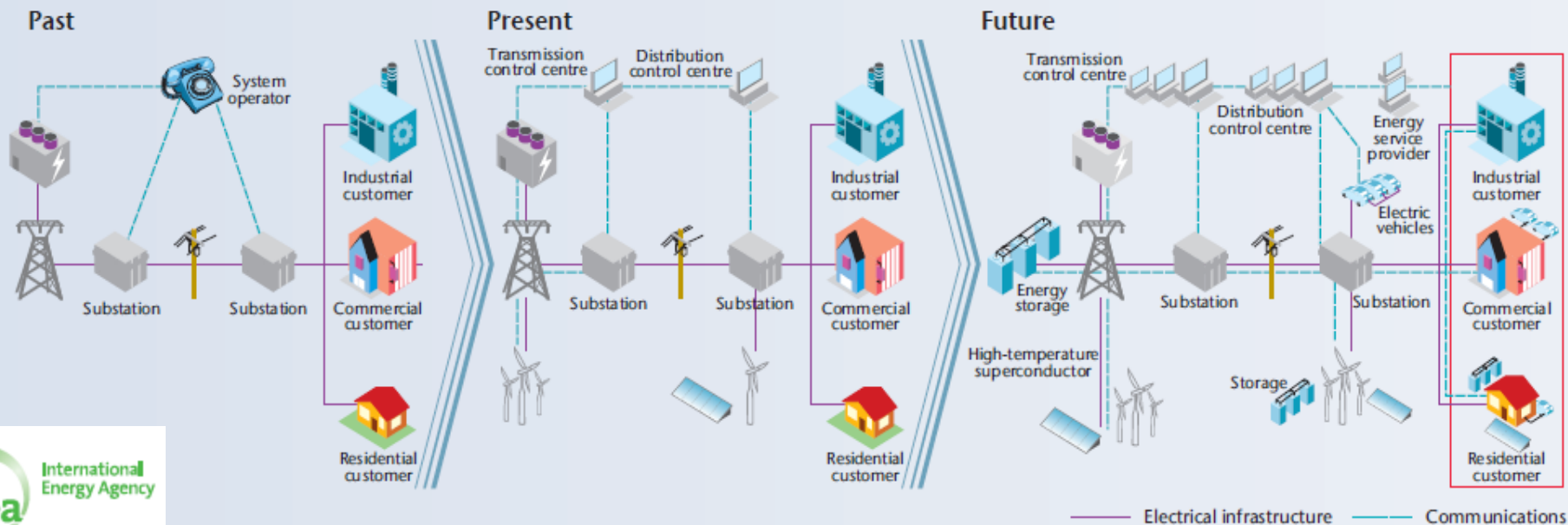Joe Durkan SEAI
September 13th, 2012

Smartgrid Roadmap

"Borrow" a working definition

The basic concept:

- maximizing throughput of the electricity delivery system while reducing the energy consumption
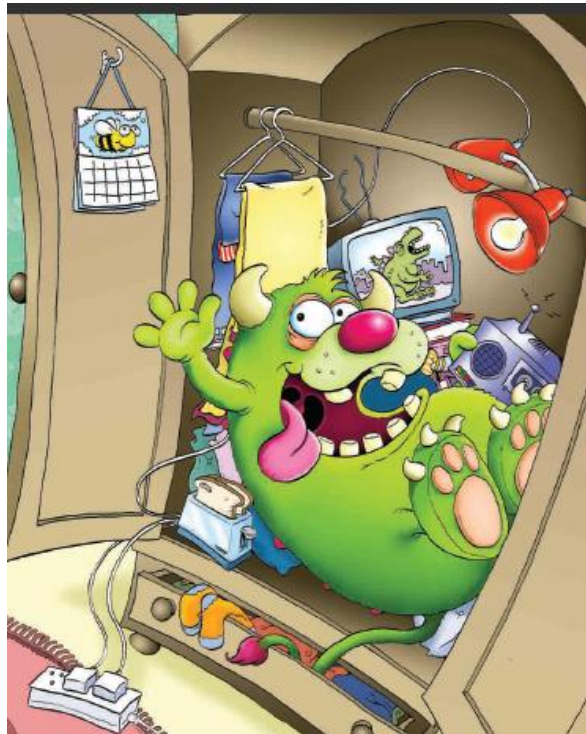 - monitoring, analysis, control, communication

The evolutionary process of "smartening" the grid

Smart Grid
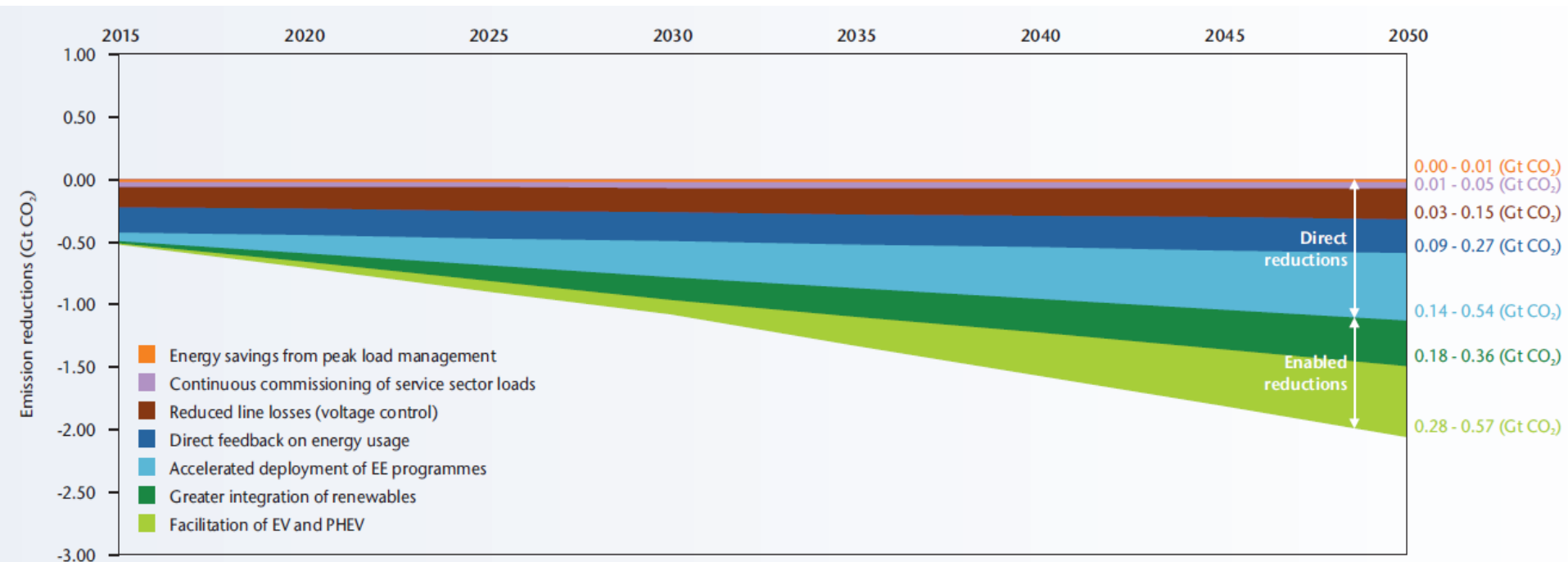
Or, more simply...

Balancing variable supply
with demand
without breaking the system

Smart Grid Roadmap

IEA – Guide to Roadmap Development

- Goals – set clear and concise set of targets

- Milestones – specific dates for interim performance targets

- Identify Gaps and Barriers

- Action items – to overcome gaps and barriers

- Priorities and timelines.

Assess for fitness

Big picture too broad...

Figure 13. Regional CO$_2$ emissions reduction from smart grid deployment

Direct reductions: energy savings from peak load management, continuous commissioning of service sector loads, accelerated deployment of energy efficiency programmes, reduced line losses and direct feedback on energy usage

Enabled reductions: greater integration of renewables and facilitation of EV and PHEV deployment

Over emphases on EV / PHEV
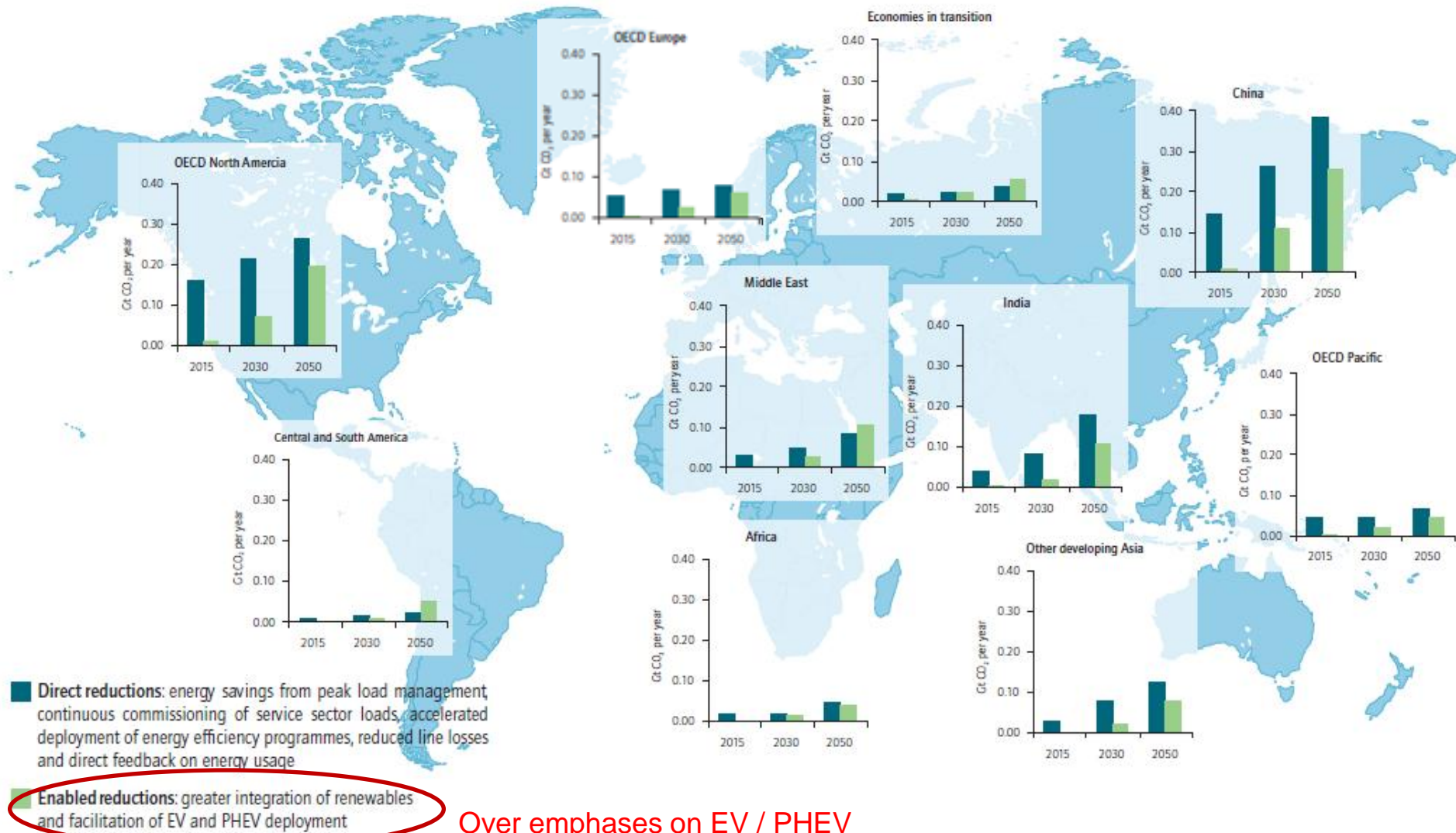
... and too general

Figure 4. Portion of variable generation of electricity by region (BLUE Map Scenario)

Ireland's target is 40% by 2020
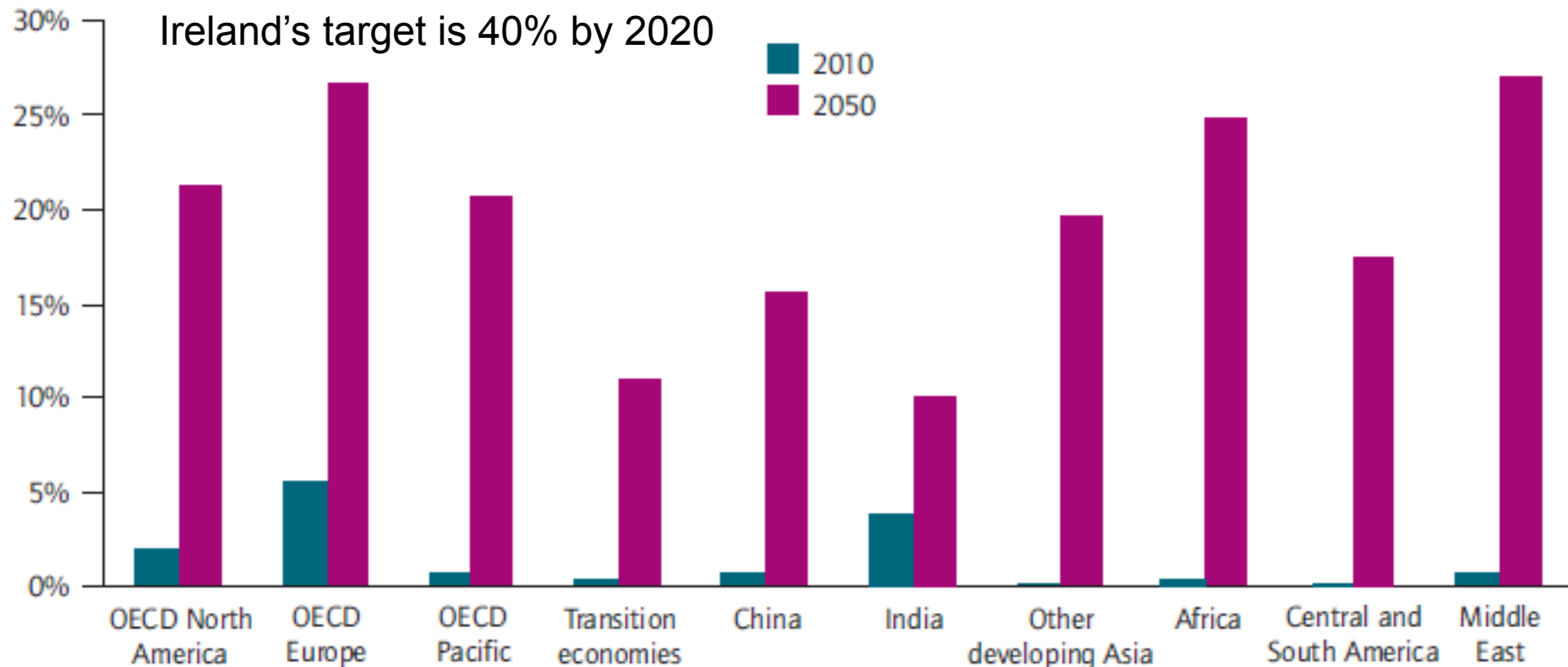
Source: IEA, 2010.

KEY POINT: *All regions will need smart grids to enable the effective integration of significantly higher amounts of variable resources to their electricity grids.*

Roadmap:
Know where you're starting from

Smart Grid – the background

RENEWABLE ELECTRICITY

40%

TRANSPORT ENERGY

10%

ENERGY EFFICIENCY

20%

by 2020:

- 40% of electricity to come from renewable sources
- 10% of transport energy to be renewable and 10% of passenger vehicles to be electric
- 20% increase in energy efficiency
- Commitment to deploy smart meters on a national basis
- Funding of over €10 billion on grid and network development

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Ireland's Unique Characteristics

- **Small, Advanced Electricity System**
  - Relatively small isolated system
  - 40% renewable challenging
  - New operational strategies and market mechanisms required

- **Single Electricity market**
  - One market
  - One transmission system operator
  - One distribution system operator
  - One great opportunity

Ireland's Unique Characteristics

- **ICT Infrastructure**
  - IBM, Cisco, Ericsson, Google, Intel …
  - proven record

- **Research Structure**
  - Focus on industry partnership
  - Electricity Research Centre, IERC…

- **Innovative Smart Grid Companies**
  - Software development
  - Energy services
  - Network technologies
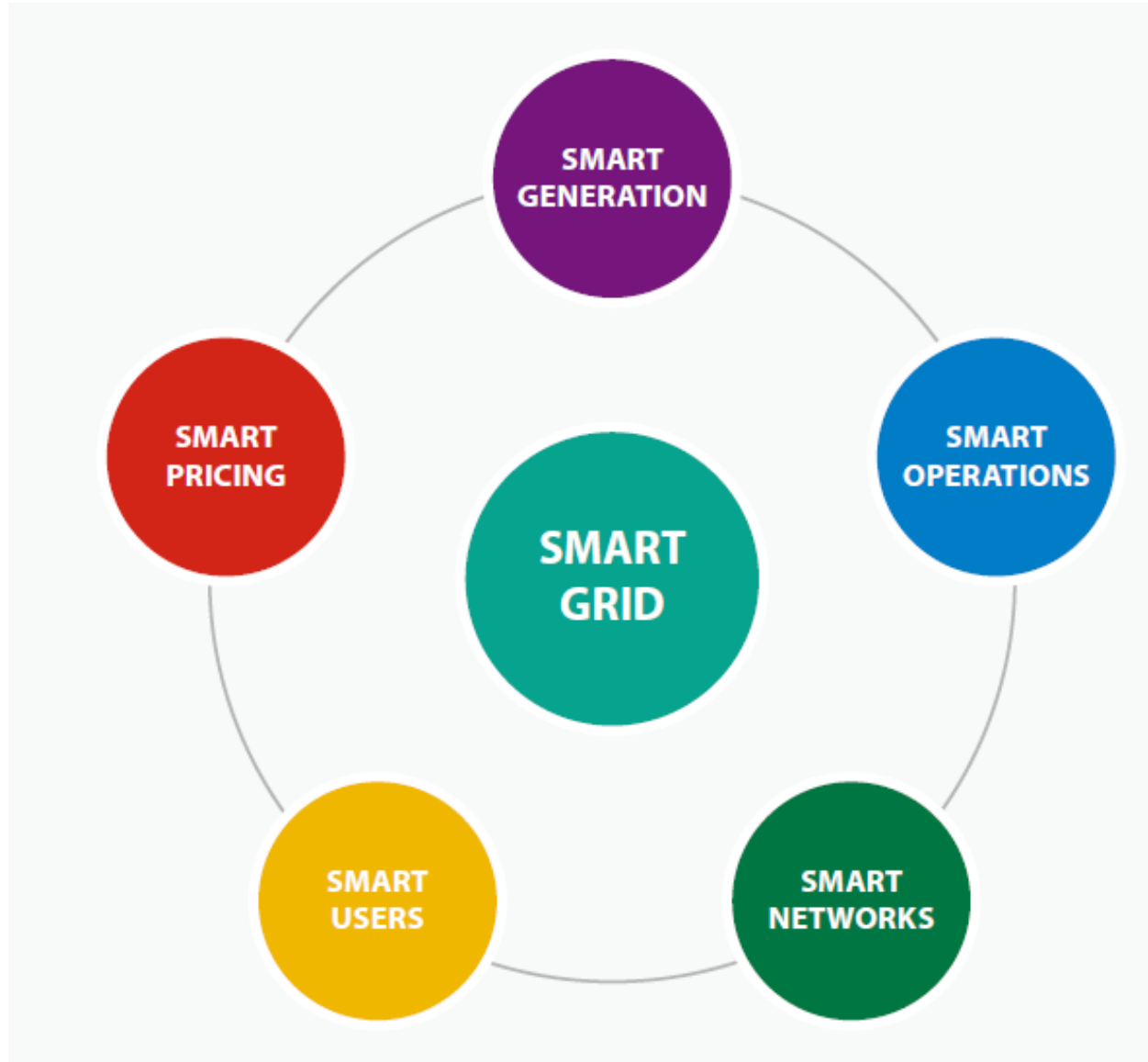
Smart Grid – Activities
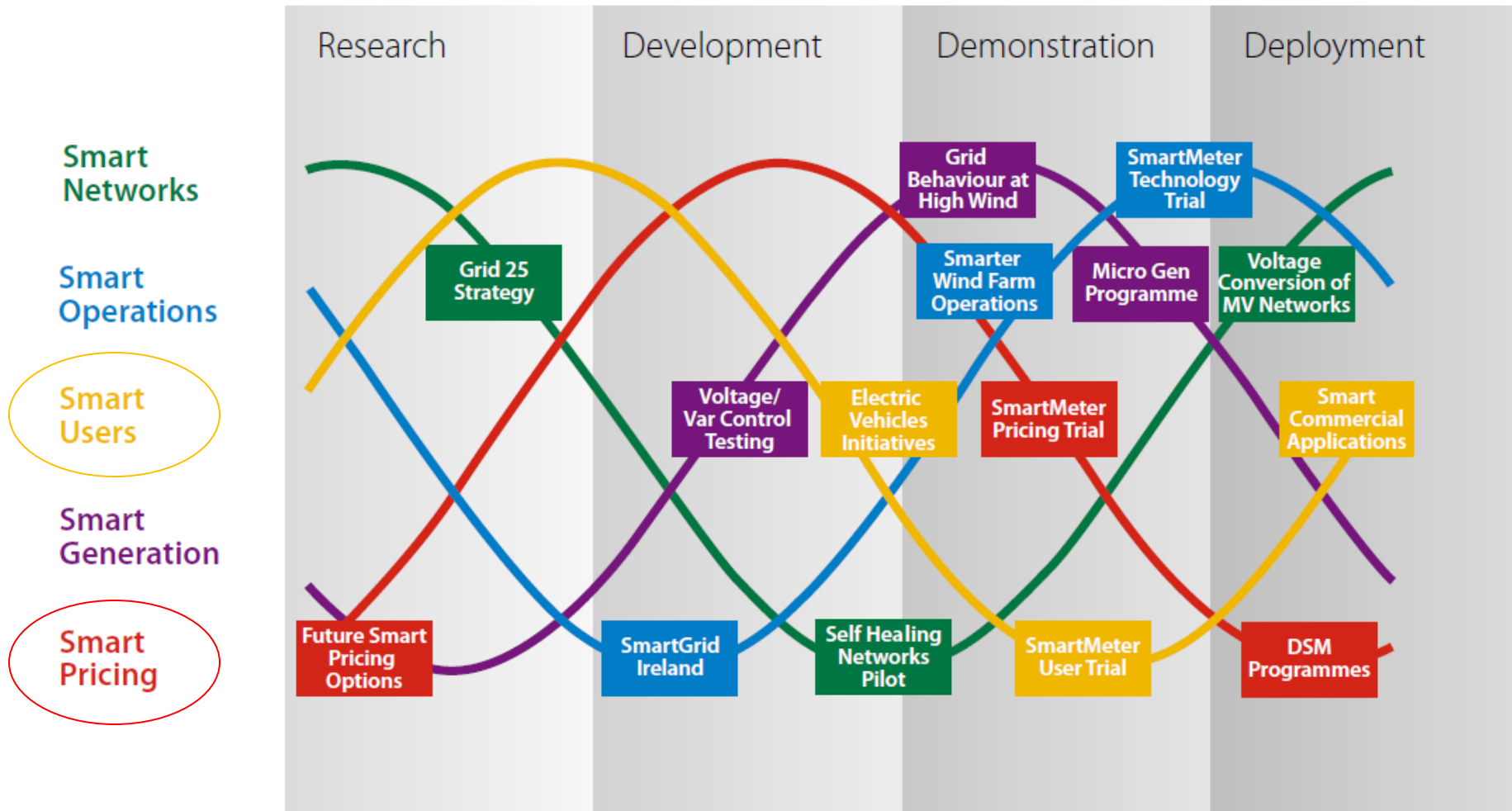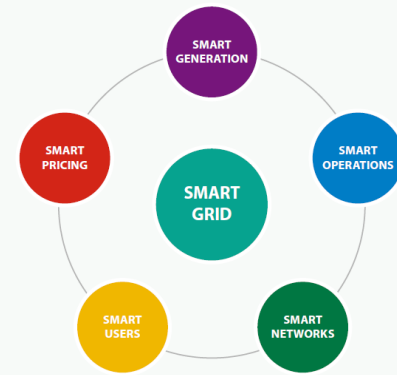
Assemble steering committee and stakeholders....

Outputs

The Smart Grid

The Smart Grid

Smart Renewables:
Maximised renewable generation; Matching demand and load to wind availability; Enabling micro generation (CHP / PV); Enabling prosumers; Virtual Power Plants…

Smart Places:
Smart Meter enabled Automated Load Control / Smart Appliances / Demand Side Management / Variable Tariffs; Home Area Networks / Building Energy Management systems; EV charging; Renewable electrification of Space and Water Heating and Cooling systems; Renewable electrification of industrial heating and cooling process loads…

Smart Transport:
Smart Meter enabled electric vehicle (battery, plug-in hybrid) charging; Vehicle to Grid charging (V2G); Large scale electrification of transport…

Smart Renewables

Smart Places

Smart Transport

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

The Smart Grid

Smart Grid:
The smart grid provides the infrastructure, policy and market conditions that will efficiently and intelligently integrate the behaviour and actions of all users connected to it…
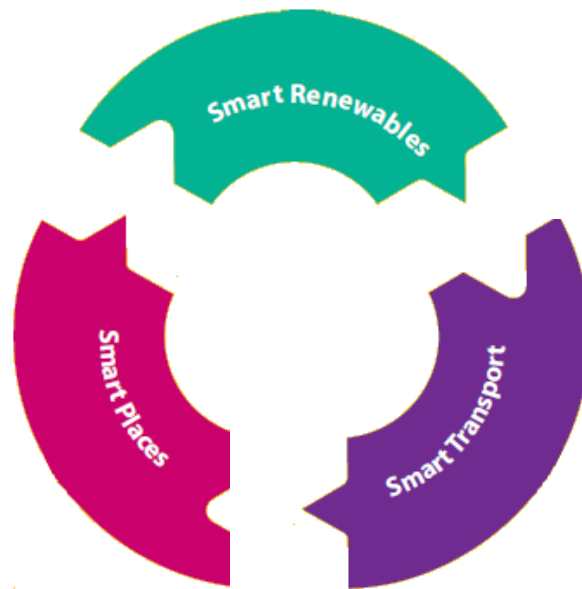
Smart Places:
Smart Meter enabled Automated Load Control / Smart Appliances / Demand Side Management / Variable Tariffs; Home Area Networks / Building Energy Management systems; EV charging; Renewable electrification of Space and Water Heating and Cooling systems; Renewable electrification of industrial heating and cooling process loads…

Smart Renewables:
Maximised renewable generation; Matching demand and load to wind availability; Enabling micro generation (CHP / PV); Enabling prosumers; Virtual Power Plants…

Smart Transport:
Smart Meter enabled electric vehicle (battery, plug-in hybrid) charging; Vehicle to Grid charging (V2G); Large scale electrification of transport…

Smart Renewables

Smart Places

Smart Transport

SMART MARKET

SMART GRID

Reduction in electricity related emissions vs. Base Case

Timeline: 2010 — 2020 — 2030 — 2040 — 2050

Legend (emission categories):
- Peak and load shifting & DSM
- Reduced line losses, infastructure improvements, volt / var management
- Integration of renewables
- Electrification of transport
- Electrification of heating, cooling, hot water
- Electrification of industrial heating / cooling loads

Chart Y-axis: Emission Reductions Mt CO_2 (0 to -16)
Chart X-axis: 2010, 2015, 2020, 2025, 2030, 2035, 2040, 2045, 2050

Chart annotations:
- Smart Meter Rollout Complete
- Grid 25 complete
- > 600,000 domestic EVs
- Wind energy meets > 30 TWh of final electricity demand
- Residential electricity demand exceeds 10,000 GWh

2050:
Annual CO_2 Savings	13.4Mt
Total Fuel Imports Offset	4,300 ktoe
Savings (@$111, $179, $247 barrel of oil)	€2.4bn, €3.8bn, €5.2bn

Right side labels:
- Direct Smart Grid
- Smart Grid Facilitated

POLICY, FRAMEWORKS & SUPPORTS
- National rollout Smart Meters
- Building regulations reviewed to stimulate infrastructure for electrification of residential heat and EV charging
- Introduce appropriate incentives to encourage uptake of EVs and electrical residential heating
- CO_2 rating of buildings introduced
- Develop standard contract structures between aggregators and capacity providers
- Market development facilitating demand side participation including appropriate capacity payments and system services
- Technical standardisation, regularisation of communication protocols
- Address privacy, ownership and security of customer usage information
- Tackle cyber security issues proactively through standards, regulation and best practice

INFRASTRUCTURE
- Continuing Investment in Grid / Network communication systems
- Grid25 – 60% increase capacity, 1,400MW interconnection
- Additional 1,500 HVDC interconnection
- Installed Wind capacity increases to > 11,000 MW, infrastructure improvements
- Enable market entry of "virtual power plants" and facilitate active participation from distributed generation
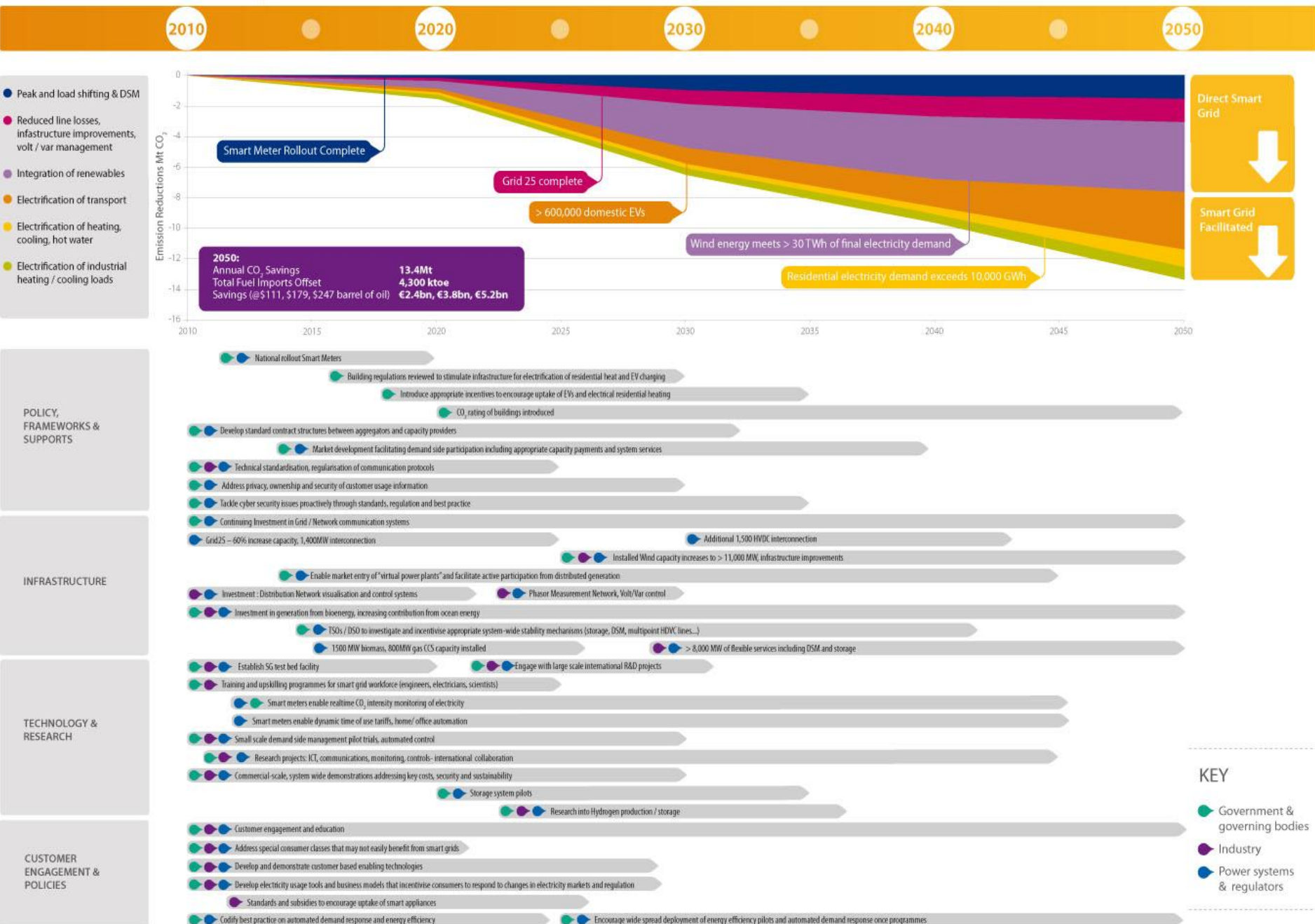- Investment : Distribution Network visualisation and control systems
- Phasor Measurement Network, Volt/Var control
- Investment in generation from bioenergy, increasing contribution from ocean energy
- TSOs / DSO to investigate and incentivise appropriate system-wide stability mechanisms (storage, DSM, multipoint HVDC lines...)
- 1500 MW biomass, 800MW gas CCS capacity installed
- > 8,000 MW of flexible services including DSM and storage

TECHNOLOGY & RESEARCH
- Establish SG test bed facility
- Engage with large scale international R&D projects
- Training and upskilling programmes for smart grid workforce (engineers, electricians, scientists)
- Smart meters enable realtime CO_2 intensity monitoring of electricity
- Smart meters enable dynamic time of use tariffs, home/ office automation
- Small scale demand side management pilot trials, automated control
- Research projects: ICT, communications, monitoring, controls- international collaboration
- Commercial-scale, system wide demonstrations addressing key costs, security and sustainability
- Storage system pilots
- Research into Hydrogen production / storage

CUSTOMER ENGAGEMENT & POLICIES
- Customer engagement and education
- Address special consumer classes that may not easily benefit from smart grids
- Develop and demonstrate customer based enabling technologies
- Develop electricity usage tools and business models that incentivise consumers to respond to changes in electricity markets and regulation
- Standards and subsidies to encourage uptake of smart appliances
- Codify best practice on automated demand response and energy efficiency
- Encourage wide spread deployment of energy efficiency pilots and automated demand response once programmes

KEY
- Government & governing bodies
- Industry
- Power systems & regulators

When developing a rodmap, keep in mind:

- One size doesn't fit all

- Roadmap should not be stand alone

- Work within existing policy

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Thank You:

joe.durkan@seai.ie