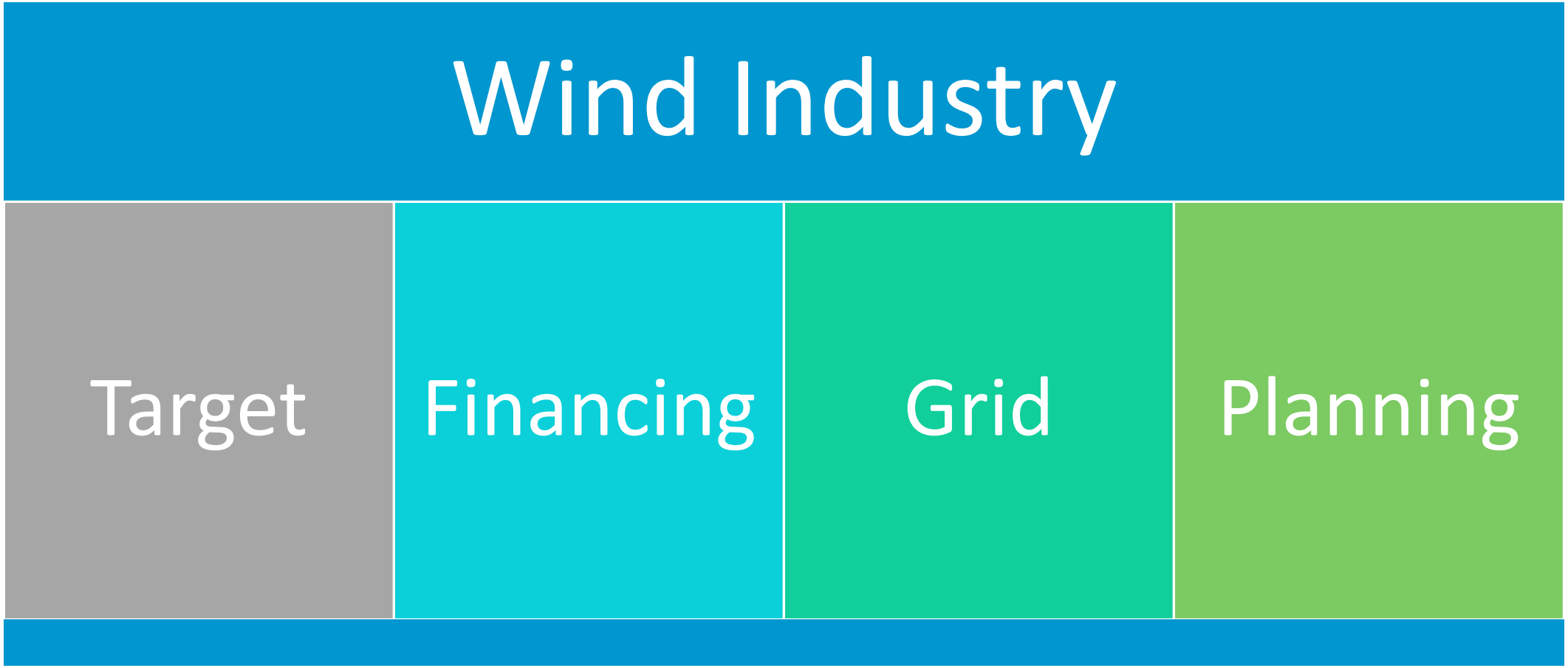
Intro & IWEA's 2030 Energy Vision

DR. DAVID CONNOLLY, CEO, IWEA

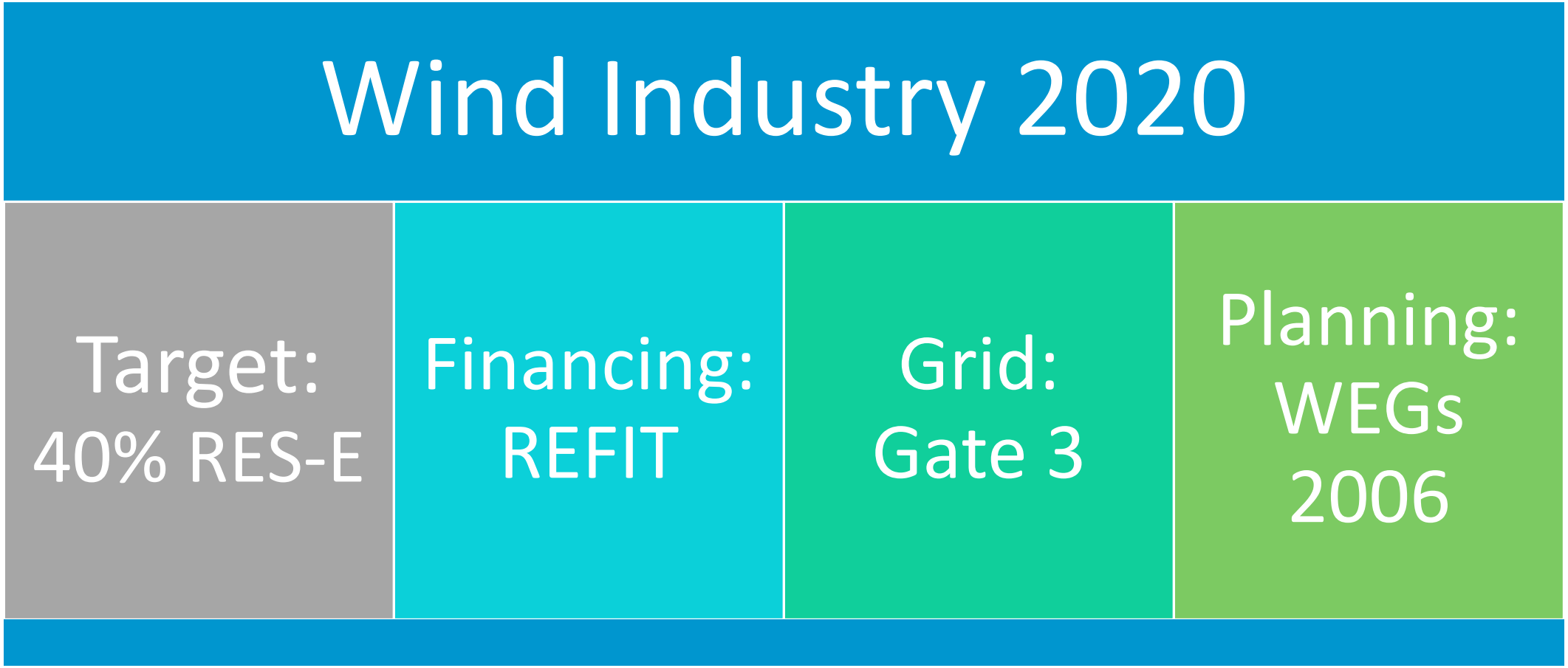
IWEA BREAKFAST BRIEFING - CLEAN ENERGY PACKAGE

13TH APRIL 2018

Pillars of Wind Industry



Pillars of Wind Industry: 2020

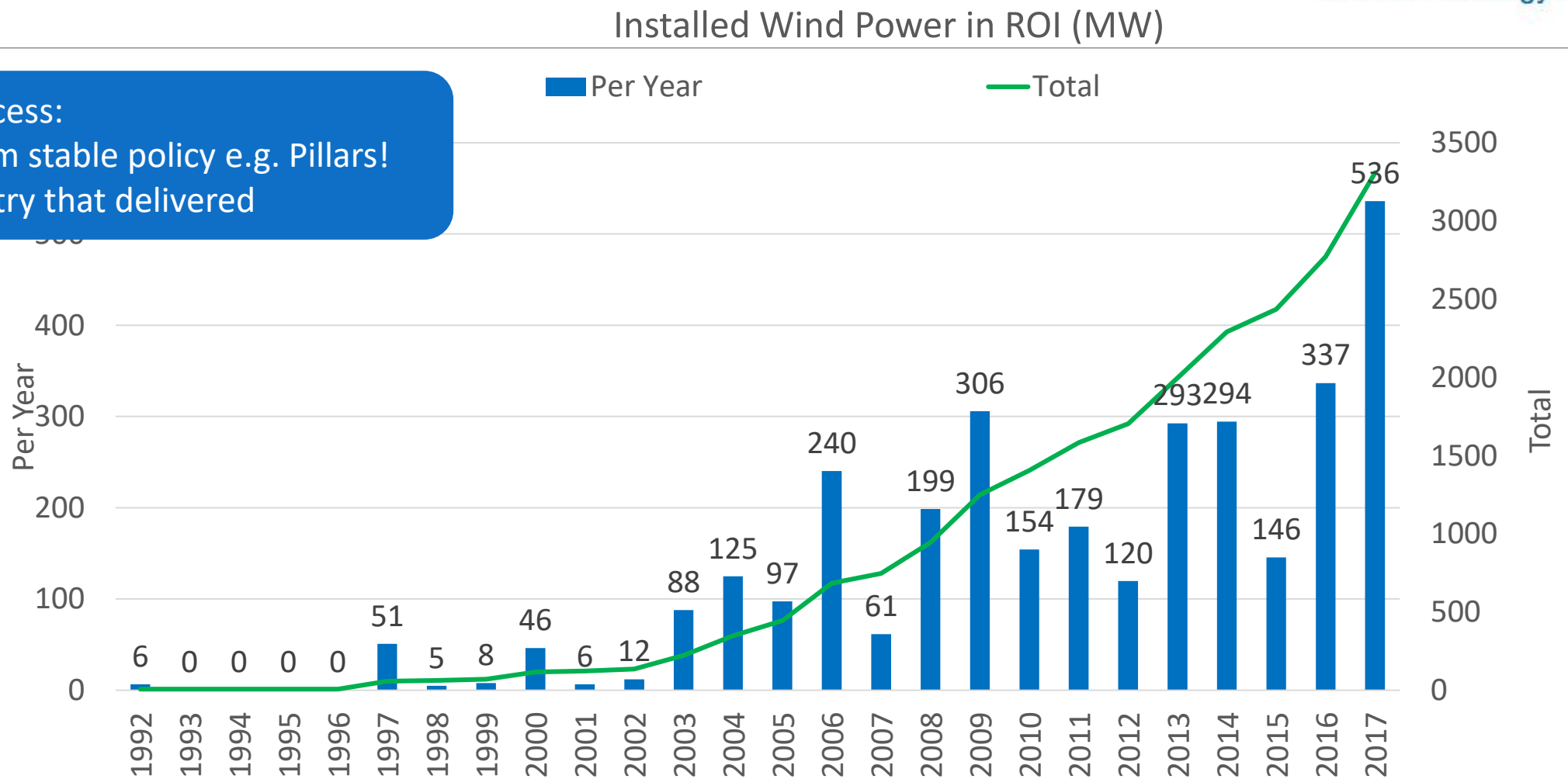


These Pillars Are Delivering for 2020

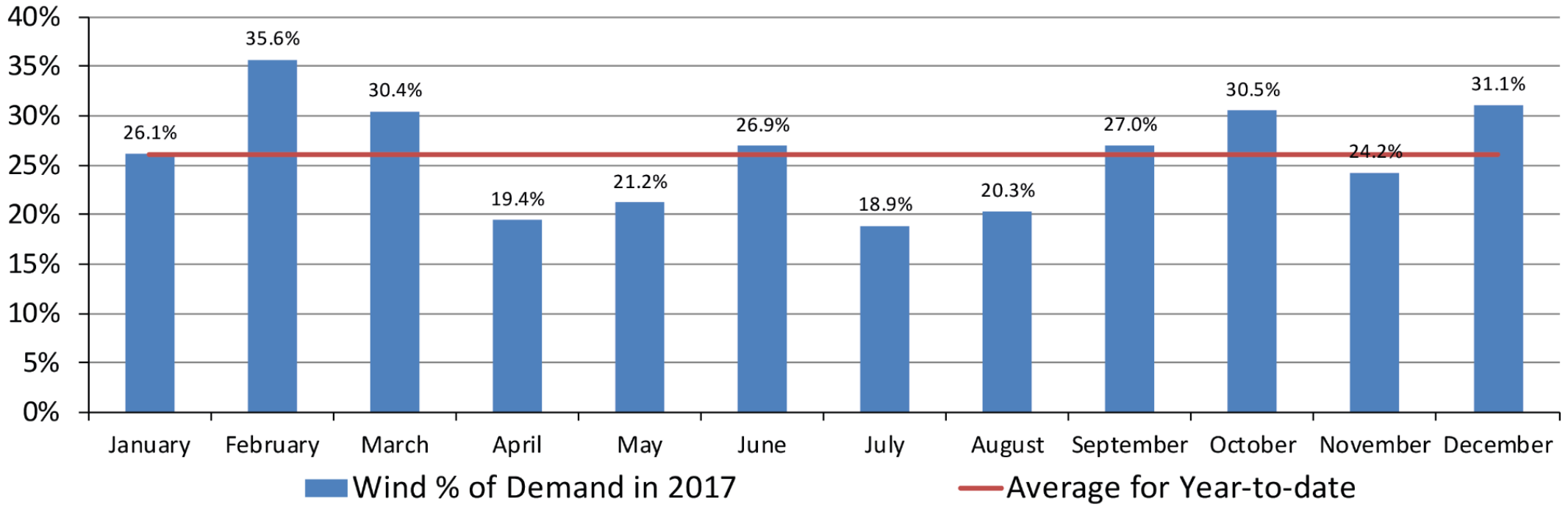
WIND POWER CONTRIBUTION IN IRELAND

Wind Industry Can Now Deliver >500 MW/year:

Key To Success:
1.Long-term stable policy e.g. Pillars!
2.An industry that delivered



Wind Power in 2017: 26% of Electricity in Ireland



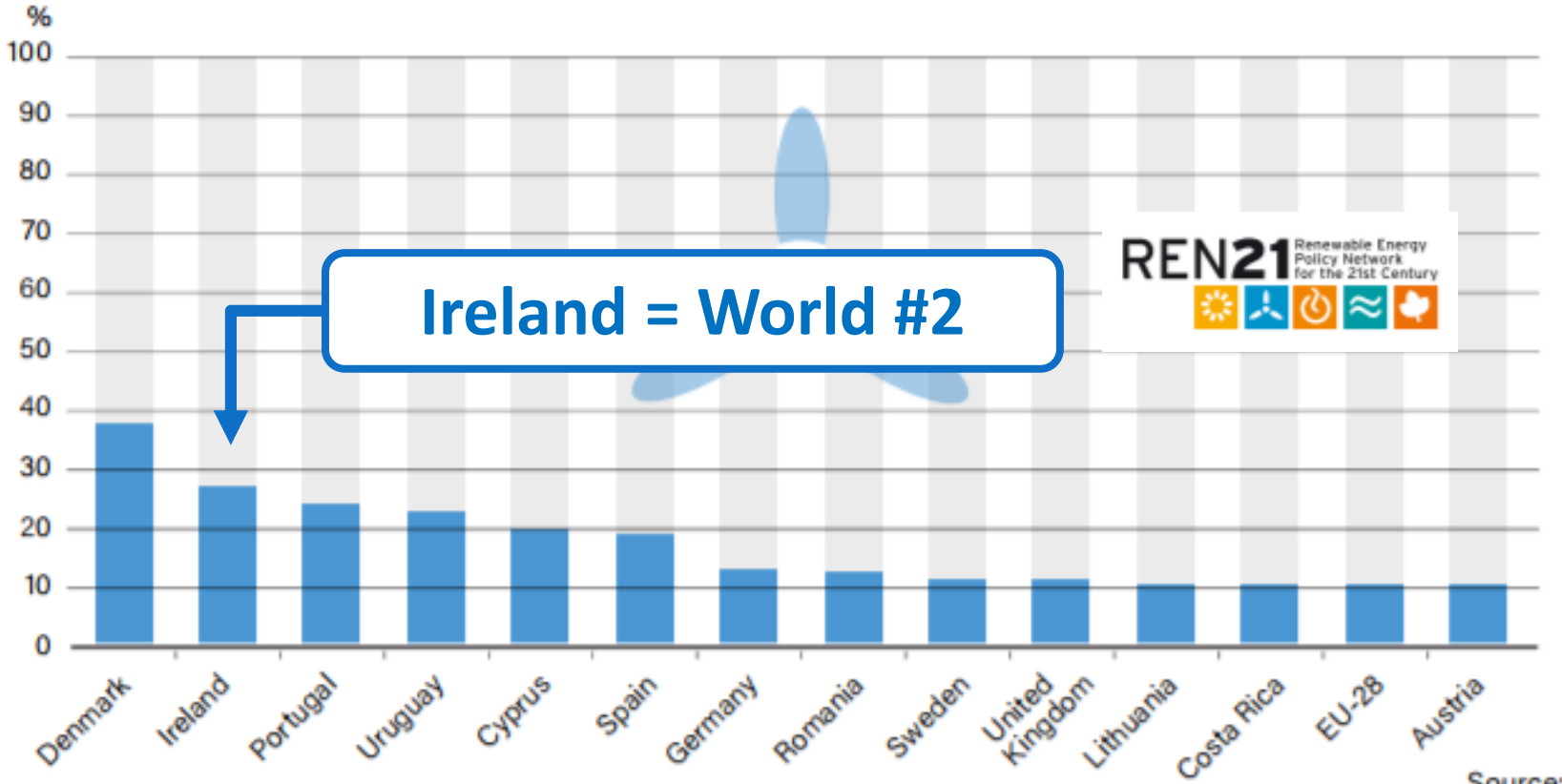
Impact of 26% Wind:
Estimated reduction in CO_2 emissions: ~3 Mt
Estimated reduction in imported fossil fuels: ~€185 Million

Graph: Martin Howley, SEAI

This Makes Ireland a World Leader

Irish Wind Energy Association

Figure 29. Share of Electricity Demand Met by Wind Power, Selected Countries with over 10% and EU-28, 2016

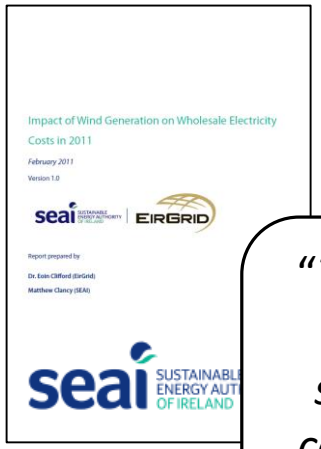


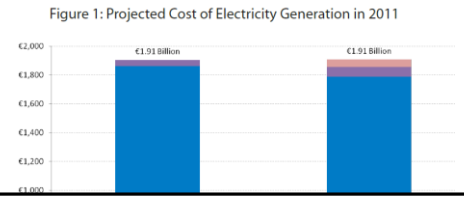
WIND has become the **LEAST-COST** option for new power generating capacity in an increasing number of markets.

Source: See endnote 94 for this section.

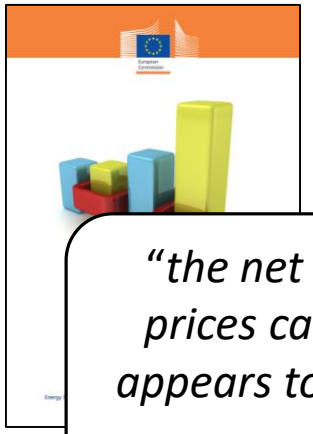
Cost of Subsidies (PSO) Offset by Reductions in Wholesale Price of Electricity Due to Wind

Irish Wind Energy Association





"This reduction in the wholesale market cost of electricity is approximately equivalent to the sum of Public Service Obligation (PSO)… total cost does not increase with the inclusion of the 2011 wind capacity" SEAI Report



"the net effect of renewable energy on retail prices can be to reduce, not raise prices. This appears to be the case in Spain and Ireland" EU Commission Report

ESRI

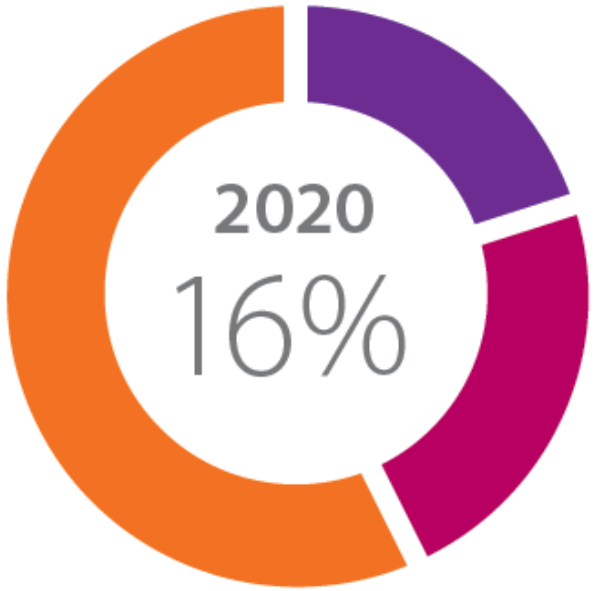
"The effect of wind remains positive after including the cost of subsidies given to wind generation" ESRI Report


THE IRISH TIMES

John FitzGerald: The benefits of renewable electricity

"Necessary investments will be expensive but in the long run they will be cost effective" Prof. John Fitzgerald

Wind Energy Expect to Supply almost Half of Ireland's 2020 Renewable Energy Target



Ireland's Renewable Energy Target

=

RES E 9%

RES H 3.7%

RES T 3.2%

=

40% Renewable Electricity

OTHERS 3-5% RES-E

WIND 35-37% RES-E

=~7-8% RES

(Saving >€700 Million)

Renewable Electricity

Clean Energy Package: Pillars for 2030?

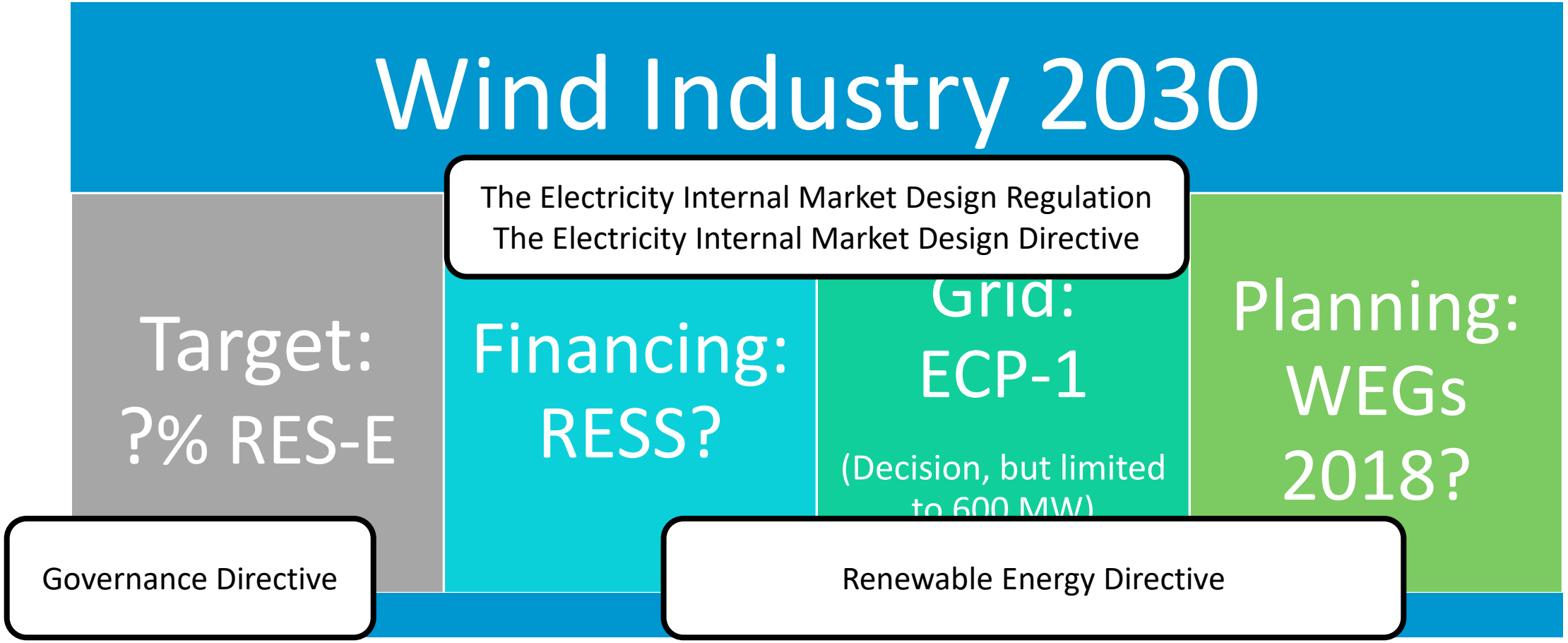
Pillars of Wind Industry: 2030 – Current Status

Irish Wind Energy Association

Wind Industry 2030

Target: ?% RES-E	Financing: RESS?	Grid: ECP-1 (Decision, but limited to 600 MW)	Planning: WEGs 2018?

Pillars of Wind Industry: 2030 – Current Status



Pillars of Wind Industry: 2030 – Current Status

IWEA
Irish Wind Energy Association

Electricity Market Directive
Elaine O'Connell
Commission Directorate - General for Energy

The Electricity Internal Market Design Regulation
The Electricity Internal Market Design Directive

Target:
?% RES-E

Financing:
RESS?

Grid:
ECP-1

(Decision, but limited to 600 MW)

Planning
WEGs
2018?

Victor Charbonnier
Advisor – Grid Int.
Wind EUROPE

Governance Directive

Nicole Ridge
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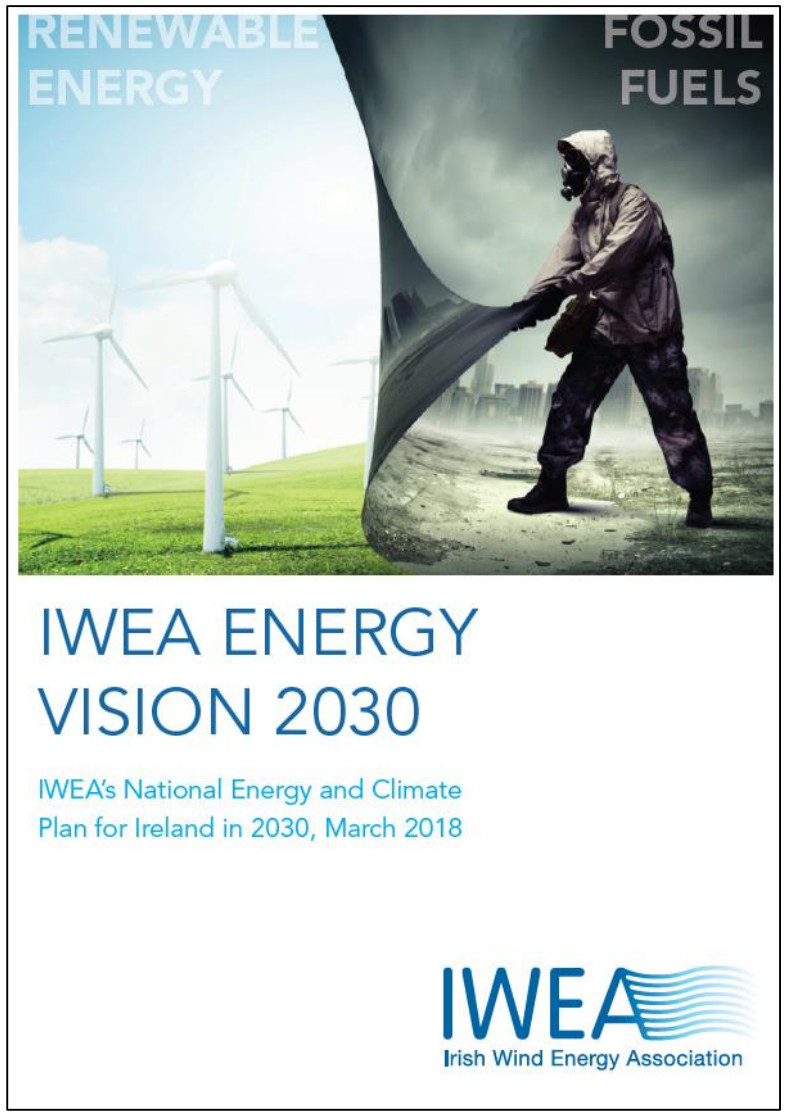
Renewable Energy Directive

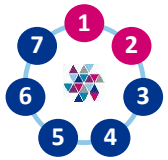


The Opportunity: 70% RES-E by 2030

1. Beyond 40% Renewable Electricity
   - More DS3: Higher SNSP & Lower Min Gen
   - Interconnection, Batteries

2. Beyond the Electricity S
   - Heat via Heat Pumps
   - Transport via Electric Vehicles

Model approach: day-ahead power



We project spot wholesale electricity prices using our industry-leading pan-European hourly dispatch model, based on economic fundamentals and calibrated for the RAs

What questions does it answer?

- What will be the level and volatility of future day-ahead and intra-day power prices, and their sensitivity to different scenarios and outcomes?
- How will assets be dispatched in these timeframes on an hourly basis?
- What energy gross margins will be earned by different generation assets and technologies?
- What will the level of 'uplift' be, above short-run marginal costs?
- How will hourly price 'shape' change over time?

Key inputs

- Scenario inputs: fuel and carbon prices, demand (growth and shape), plant build, plant retirement
- Detailed pan-EU plant level database: installed capacity, efficiencies, operating costs, operating constraints
- Cross-border interconnector capacity
- Detailed hourly wind and solar profiles

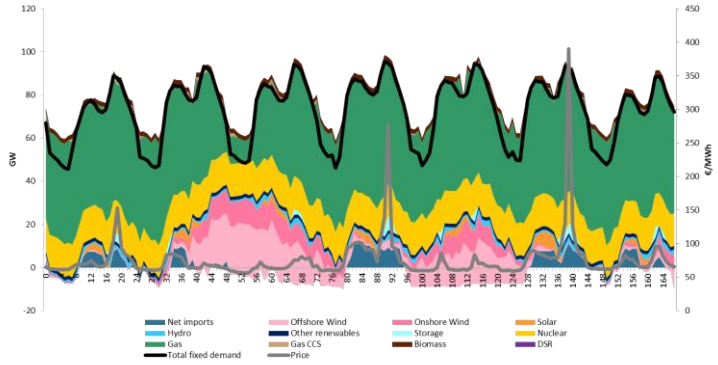
Model engine

- Hourly dispatch, least-cost optimisation framework using the PLEXOS platform
- Optimisation of operational constraints including start costs, ramp rates, heat rates
- Maintenance scheduling and unplanned outages

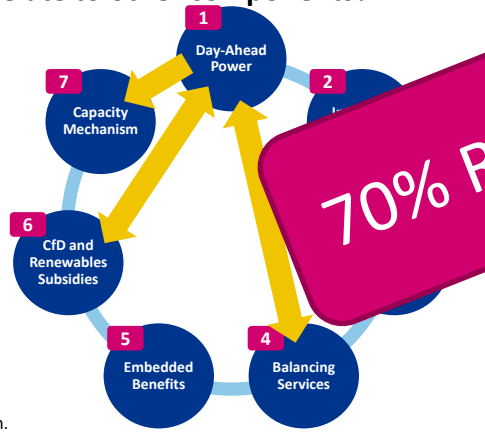
Key outputs

- Wholesale electricity prices
- Generation schedules
- Asset energy revenues and gross margins
- Emissions
- Dispatch costs
- Cross-border flows (imports / export

Illustrative schematic



How does it relate to other components?



70% RES-E Technically Possible!

2030 Scenarios in IWEA's Energy Vision

1

Fossil Fuels

No additional renewable electricity beyond 2020, so Ireland has 37% of renewable electricity by 2030

2

Renewable Energy

70% of electricity is met with renewables by 2030, primarily by wind and solar power

All Island Numbers	2020 Assumptions	Fossil Fuel 2030	Renewable Energy 2030
% RES-E	41%	37%	70%
Total Electricity Demand (TWh)	40.4	45.9	48.3
Wind Power (MW)	4800	4800	10,000
Solar Power (MW)	320	320	2900
Interconnection (MW)	580	580	2030
SNSP Limit	70%	70%	90%
Min Gen (MW)	1000	1000	700
Electric Vehicles (nr)	0	0	630,000 (ROI 426,000*)
Heat Pumps (nr)	0	0	396,000 (ROI 279,000*)
Small Scale Battery Storage (MW)	0	0	500
Large Scale Battery Storage (MW)	0	0	1200

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Irish Wind Energy Association

Input Assumptions

All Island

Onshore wind - large		2020	2025	2030
Capex	*€/kW*	1529	1473	1434
Fixed Opex	*€/kW/year*	52.8	50.8	49.7
WACC (real, pre-tax)		10%	10%	10%
Total constr time	*years*	2	2	2
Economic life	*years*	20	20	20
Load factor pre-curtailment		35%	35%	35%
Load factor post-curtailment		34%	33%	33%
LCOE	*€/MWh*	**81.6**	**78.6**	**76.7**

Solar - large		2020	2025	2030
Capex	*€/kW*	882	787	732
Fixed Opex	*€/kW/year*	12.2	11.2	10.2
WACC (real, pre-tax)		10%	10%	10%
Total constr time	*years*	1.75	1.75	1.75
Economic life	*years*	25	25	25
Load factor pre-curtailment		11%	11%	11%
Load factor post-curtailment		11%	10%	11%
LCOE	*€/MWh*	**121.0**	**108.2**	**100.4**

High Cost Assumptions in Line with RESS Consultation

Roinn Cumarsáide, Gníomhaithe ar son na hAeráide & Comhshaoil
Department of Communications, Climate Action & Environment

WSP | PARSONS BRINCKERHOFF

Headline results

Our analysis indicates that a 2030 70% all-island RES-E scenario is cost neutral for end consumers in the Republic of Ireland with a 20% LCOE reduction

- For the Renewable Energy scenario, our analysis indicates a net consumer cost of around € 1.5 bn, with RES support, constraint costs, network costs and DS3 costs offset by:
  - Lower wholesale electricity prices, driven by the high RES-E deployment, leading to lower end consumer energy costs
  - CRM cost savings, as less conventional thermal new build is required
  - Transport and heat savings
- Our calculations show that a modest 20% reduction in LCOEs, equivalent to reducing the large onshore wind LCOE to €61/MWh, for the Renewable Energy scenario results in breakeven for the Irish consumers

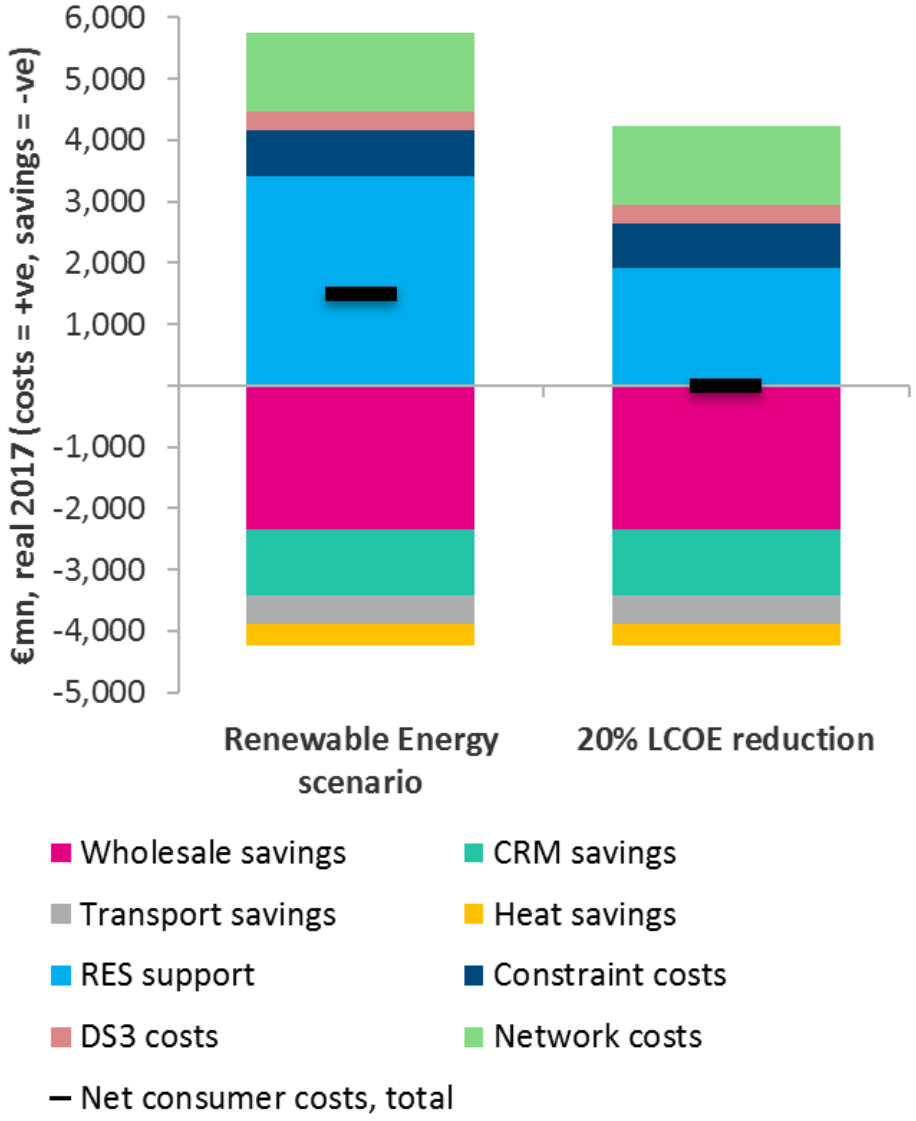
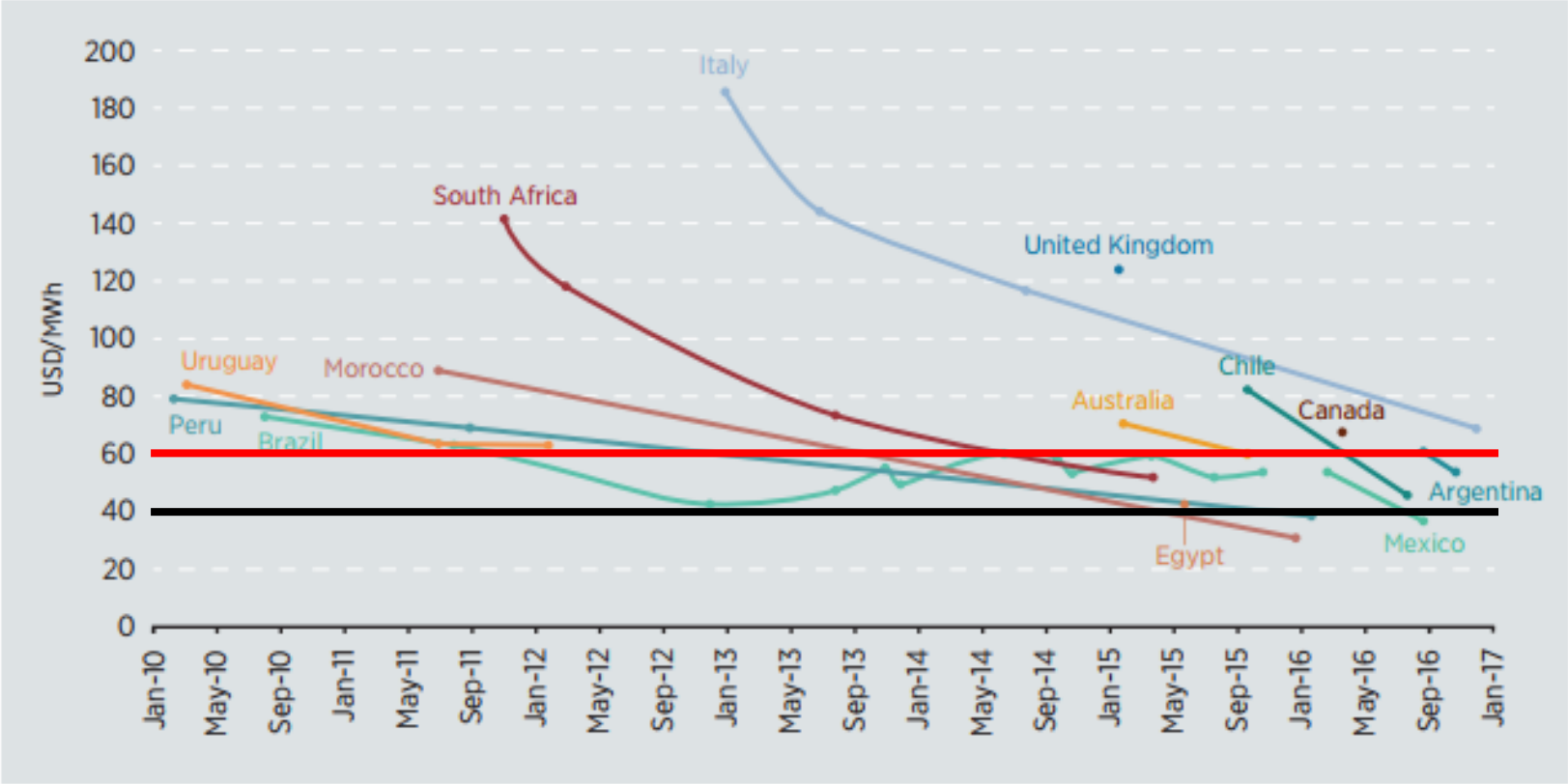


Figure 2.9 Evolution of average auction prices for onshore wind energy, January 2010-January 2017

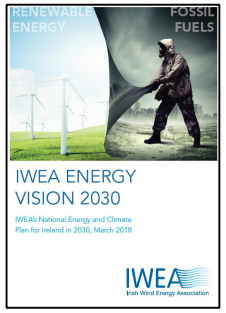


Note: Prices are averages. On the rare occasion when multiple auctions occurred within the same month, the average price of those auctions is shown. In case of ambiguity regarding the auction's date, the date when the winning bids were selected and announced was taken as the main reference.

Source: Based on BNEF (2016a, b), ANEEL (2016), Bailey (2016), Bierzwinsky and Felix (2016), Coordinador Eléctrico Nacional (2016), Eberhard and Kåberger (2016), Enel (2016), Elizondo-Azuela, Barroso et al. (2014), GSE (2016), MINEM (2016a, b), Osinergmin (2016), Santiago and Sinclair (2017a, b), Tsanova, 2016a.

IRENA Onshore Wind Auctions 2010-2017

IRENA
International Renewable Energy Agency



IWEA Energy Vision: Conclusions

IWEA Irish Wind Energy Association

1. Wind power can go beyond 40% renewable electricity
   - High SNSP & Lower Min Gens
   - More interconnection & batteries
2. Wind can provide renewable heat & transport via Smart Energy System:
   - Electrification reduces our energy demand
   - Enables wind power to access all forms of energy storage
3. IWEA's Energy Vision shows that a 70% RES-E Scenario by 2030 is:
   - Technically possible
   - Cost-neutral for the consumer with conservative price forecasts
4. We need Policy Support to Deliver a Cost-Neutral 70% RES-E by 2030

Some Next Steps

Download the extended PowerPoint Slideshow: www.iwea.com

More detailed report to follow with additional results and assumptions

Tell everyone that 70% RES-E is possible and cost-effective!

Hopefully we will soon know how Policy will make 70% RES-E Possible!

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