Reference Plants in the NER 300 process

Meeting with Member States

10th January 2010

Agenda

1. **Introduction and Overview**

2. **RES (sub-)categories related to electricity generation**
   - Presentation of key issues & example reference plants
   - Questions

3. **Coffee break**

4. **Bioenergy sub-categories**
   - Presentation of key issues & example reference plants
   - Questions

5. **Exchange of views between Member States**

6. **Closing remarks**

SECTION 1:
Introduction and overview

Objective of Meeting

- Provide guidance on an approach to defining reference plants for RES (sub-)categories as requested by MS
- Share worked examples of reference plants to help MS make an informed choice
- Provide a forum for Member States to share their views on the subject of reference plants

Legal basis – NER 300 Decision

- **Art. 3(3):**

  "Relevant costs of RES demonstration projects shall be those extra investment costs which are borne by the project… compared to a conventional production with the same capacity in terms of effective production of energy ..."

- **Art. 5(3):**

  Member States to provide relevant costs when submitting the proposals for funding

Roles and responsibilities - 1

- **Member States:**
  - Responsible for defining the Reference Plant for RES projects and communicating this to Project Sponsors (Para 99 point 2 of the Call)
  - Reference plant, and any associated assumptions, should be defined at an early stage in the process to enable the relevant costs to be determined in conjunction with the Project Sponsor (Para 102)

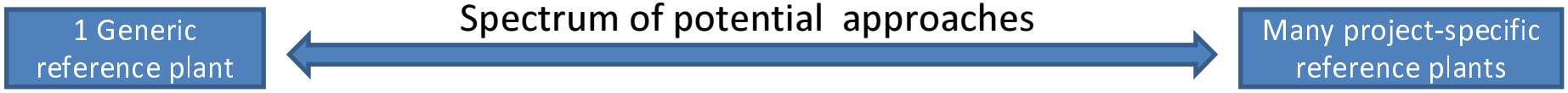
- **Project Sponsors:**
  - Project Sponsor to determine any assumptions e.g. fuel price, rate of inflation etc. for their own individual project in agreement with MS (Para 102)
  - Reference Plant and relevant costs to be determined in co-ordination with Project Sponsors (Paras 95 and 102)

Roles and responsibilities - 2

- **EIB:**
  - No role in the initial determination of the Reference Plant
  - But where relevant for the financial Due Diligence, EIB will consider whether the assumptions submitted by MS are appropriate and may, following confirmation/ discussion with the Project Sponsor, undertake alternative scenarios/ sensitivity testing based on its own assumptions and inform COM of the outcome (Procedures Manual)

- **COM:**
  - No role in the determination of the Reference Plant
  - No legal basis to issue any requirements
  - But: Guidance to help MS

Challenge: Range of options



- How many reference plants are necessary?
  - Generic or project specific
  - 34 RES sub-categories x 27 Member States?
  - MS expressed the need for a “level playing field”, which would suggest to use 1 single reference plant

Challenge and options

The challenge:

- What could be the comparable ‘conventional production’?
  - thermal, fossil-fuel power generation for electricity
  - wholesale refinery cost including margin for biofuels
  - Commercially mature renewable technology

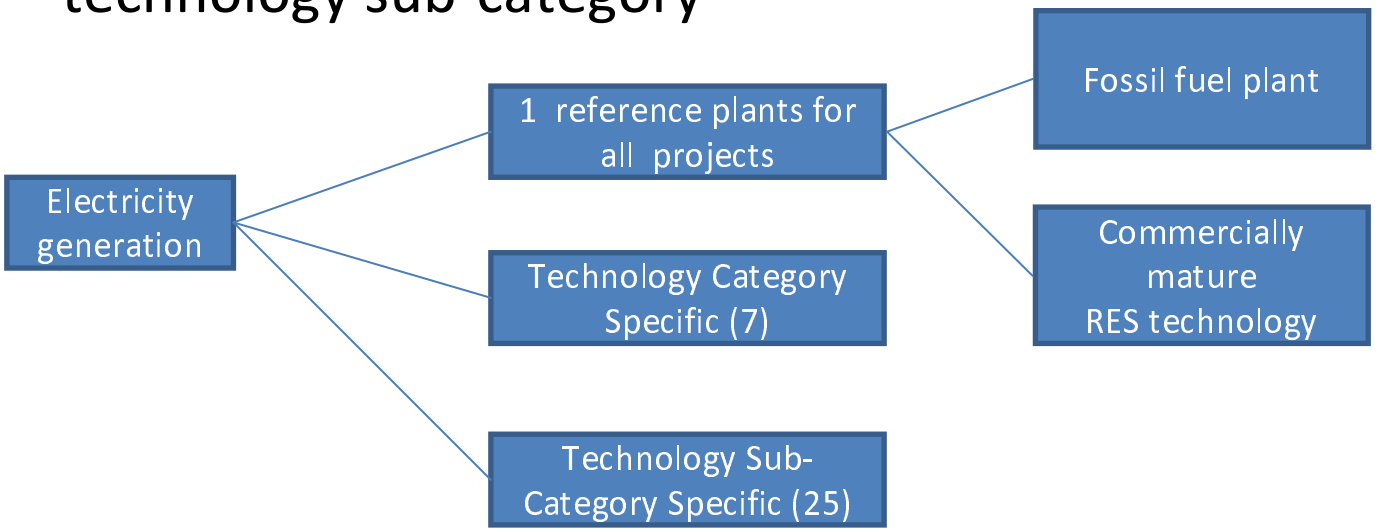
Options for NER300:

- Fossil-fuel based technologies for all RES
- Commercially mature renewable technologies for all RES

SECTION 2:
RES SUB-CATEGORIES RELATED TO ELECTRICITY GENERATION

Overview
RES sub-categories generating electricity

- CSP, PV, Geo, Wind, Ocean, Hydro & 3 bioenergy project sub-categories
- 3 potential approaches by a MS
  - 1 reference plant for all technologies
  - 7 reference plants: 1 for each technology category
  - 25 reference plants (theoretically possible): 1 for each technology sub-category



Key issues – worked examples

Approach which may offer a “level playing field” for MS

- 1 reference plant for all electricity generating RES technologies- examples:
  - Option 1: Combined Cycle Gas Turbine, or
  - Option 2 : commercially mature renewable technology

Reference Plant – electricity generating Methodology and assumptions

Methodology:

- 1. Determine type of Reference Plant in relation to RES project; i.e. load characteristic
- 2. Choose cost and other (technical) factors at a reasonable level
- 3. Calculate full cost (EUR/MWh) of Reference Plant as a proxy for its revenues

Basic assumptions needed for a Reference Plant:

- Capex (EUR/kW), Opex (% of Capex), fuel prices (e.g. aligned with fuel price forecast of international institutions, such as IEA), carbon price (e.g. at current ECX levels), load factor (% or hours/year)
- Determine on that basis Relevant Cost of RES project, adjustment of capacity and production of RefPlant to RES project through factoring in the ratio of load factor

Worked example 1 - Combined Cycle Gas Turbine

Key assumptions (illustrative only)

- 860MW, 70% load factor
- ~€600 / KW installed capacity; total capex: €558m
- Annual generation: 5,273,520 MWh
- 350kg/MWh CO2, €15 / tCO2 cost
- O&M €24/KW/yr (or ~3.5% capex)
- Fuel €7/GJ Fuel cost at 70% load factor
- Other €9/kW/yr (staff, administrative and insurance costs)

(Detail to be provided in Submission Form 4)

Worked example 2 - Onshore Wind

Key Assumptions (illustrative only)

- 2MW onshore wind turbine,
- ~30% operating factor
- ~€1200 / KW installed capacity, capex €2.454m
- Annual generation: 5256 MWh
- O&M: 1.2 - 1.5 €c/kWh (average €c/kWh) : €70,956 / year

(Detail to be provided in Submission Form 4)

Data taken from EWEA 'Economics of Wind Energy', 2009

Sensitivity Analysis

- Define innovative project (offshore wind)
- Calculate relevant costs using CCGT and onshore wind as reference plants
- Assess sensitivity of relevant costs to changes in key variables

Key Parameter	Sensitivity of relevant cost to: CCGT reference	Onshore wind reference
Capital Cost	medium	high
O&M	low/very low	low
CO2 price	low	n.a.
Gas price	low	n.a.
Generation	n.a.	medium

Worked examples – comparison

CCGT:

- Greater consistency across EU in cost information for CCGT
- Level playing field when evaluating CPUP
- Costs are lower relative to onshore wind giving higher relevant costs, projects hence to receive more financial support from NER 300
- Similar approach used so far in ENV State aid guidelines
- CPUP for RES projects appears reasonable and indicates competitiveness

Onshore wind:

- Cost data for wind projects uncertain/ variable
- No level playing field when evaluating CPUP
- Costs are higher relative to CCGT giving lower relevant costs, projects hence to receive less financial support from NER 300

Conclusions

- MS are responsible for defining the reference plant
- MS may use a single reference plant for all electricity generation projects if appropriate
- Based on our analysis, it appears that CCGT is the most favourable reference plant

DRM / Smart Grids

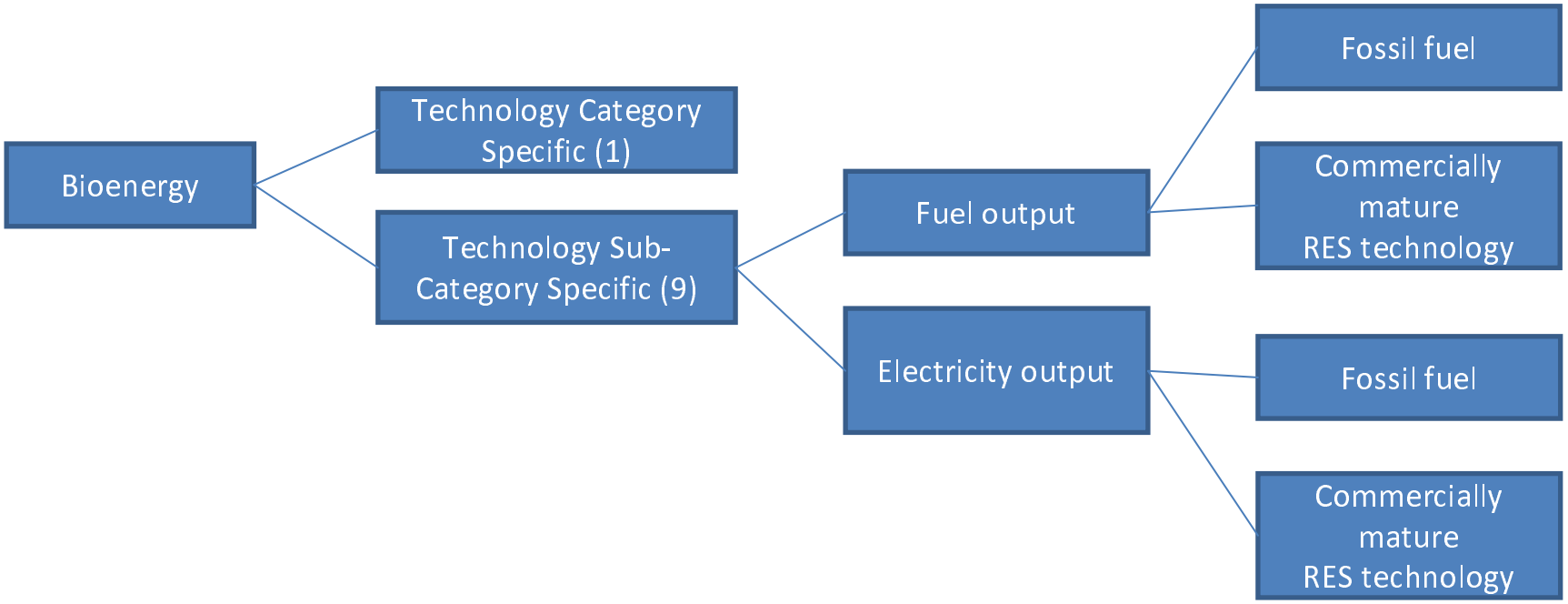
- Using a reference plant is not appropriate when defining the relevant costs of a DRM / smart grid project
- A network « reference » system should instead be defined
- The incremental equipment for DRM projects should be identified and costed.
- Interaction between Project Sponsors and Member States

Q&A

SECTION 3:
BIOENERGY SUB-CATEGORIES

Bioenergy Projects:
Overview & characteristics of Sub-Categories

- 9 sub-categories with different products
- Products: electricity, gaseous, bio-liquids, solid energy carriers
- This would indicate at least the need for 4 different (generic) RefPlants to achieve a level playing field among MS



Possible bioenergy reference plants 1/5

Sub-category	*Suggested reference plant*	*Reasoning*
BIOa. Solid liquid or slurry bioenergy carriers via pyrolysis	**Project specific capital equipment identified**	**No existing facilities at that scale**
BIOb. Solid liquid or slurry bioenergy carriers via torrefaction	**Project specific capital equipment identified**	**No existing facilities at that scale**

Possible bioenergy reference plants 2/5

Sub-category	*Suggested reference plant*	*Reasoning*
BIOc. SNG or syngas or power via gasification	**For syngas: plant producing a similar syngas composition using: •coal gasification**	**Commercially mature technology**
	For power: •CCGT •Onshore Wind	**Aligns with other electricity-producing RES categories**

Possible bioenergy reference plants 3/5

Sub-category	*Suggested reference plant*	*Reasoning*
BIOd. **Biofuels / bioliquids or power via directly heated gasification**	**For liquids:** **•Wholesale cost of equivalent fossil fuel (e.g. gasoline or diesel)** **•1st generation bioethanol or biodiesel plant**	**Commercially mature technology (either from fossil or renewable sources).** **Renewable options are the current "1st generation" processes**
	For power: **•CCGT** **•Onshore Wind**	**Aligns with other electricity-producing RES categories**

Possible bioenergy reference plants 4/5

Sub-category	*Suggested reference plant*	*Reasoning*
BlOe. Biofuels via entrained flow gasification	**As d. liquids above**	**As d. liquids above**
BlOf. Electricity at >48% efficiency	• **CCGT** • **Onshore Wind**	**Aligns with other electricity-producing RES categories**
BlOg. Alcohol via chemical and biological processes	**As d. liquids above**	**As d. liquids above**

Possible bioenergy reference plants 5/5

Sub-category	*Suggested reference plant*	*Reasoning*
BlOh. Biogas, biofuels or bioliquids via chemical and biological processes	**For biogas: anaerobic digestion plant**	**Commercially mature technology to produce biogas**
	As d. liquids above	**As d. liquids above**
BlOi. Biofuels or bioliquids via biological and chemical processes from algae and/or micro-organisms	**As d. liquids above**	**As d. liquids above**

Option 1: Fossil Fuel Reference

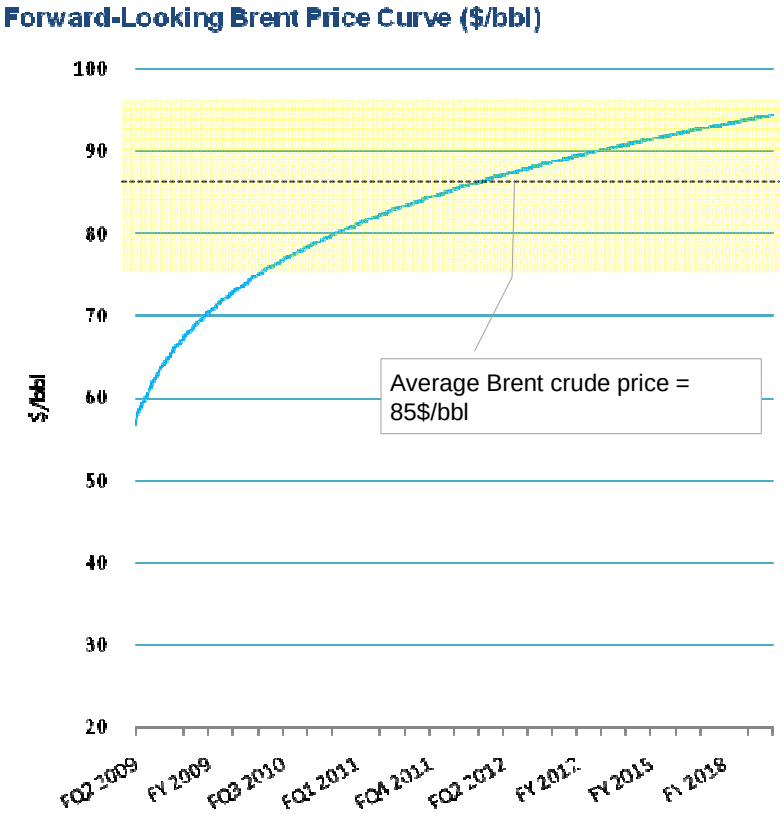
Option 1
Cost basis

- Take forward crude curve as base feedstock cost
- Define typical European refinery and typical product slate
- Determine capital costs / investment costs (or amortization)
- Calculate operating costs (e.g. energy, catalyst, manpower, maintenance etc)
- Calculate refining margin based on costs
- Calculate product prices to compare versus 2nd generation biofuels

Option 2
Economic Alternative

- Take forward-looking crude curve as base feedstock cost
- Take historic European refining margin – take a view on future long-run margin
- Infer refinery yield from refining margin
- Calculate product prices to compare versus 2nd generation biofuels

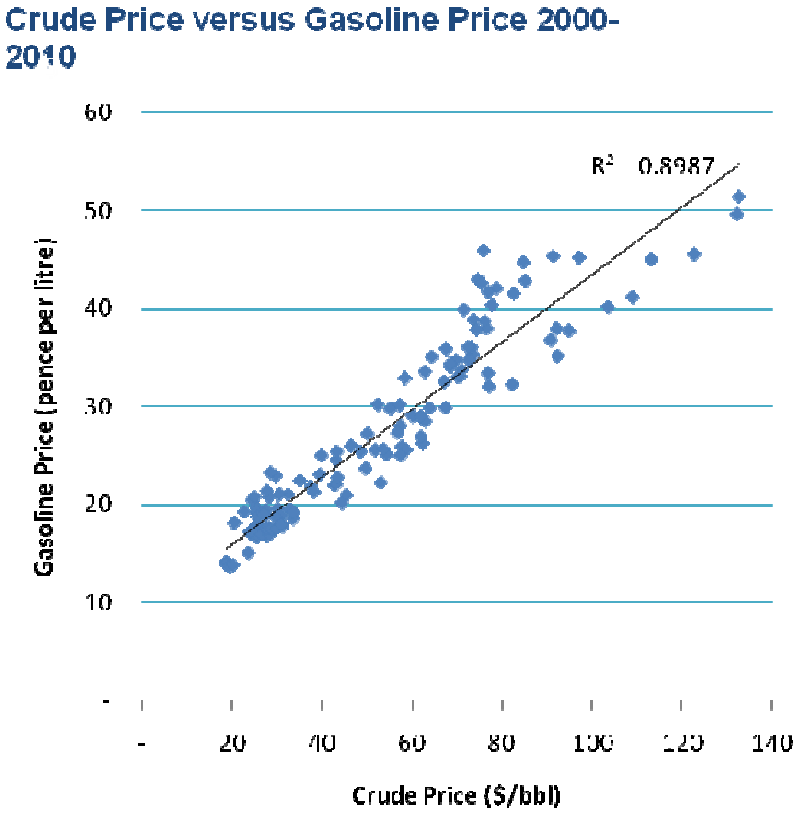
Brent crude price curve



Source: Capital IQ

- Economics based on a reference price for crude oil
- key determinant being the market forward-looking curve
- a formal crude price forecast is not required
- $85/bbl price for Brent
  - NYMEX forward curve
  - IEA 2010 reference crude price in the $80-$85/bbl range
  - EIA 2011 outlook (December 2010) of $83.5/bbl, rising to $89/bbl at year end
  - In line with planning basis for crude prices among Middle Eastern budgets

Regression of crude price against gasoline price



Source: IEA and EIA

- The plot of crude price versus gasoline price over the last 10 years shows the close correlation between the two price sets ('R-squared' = 0.8987)
- At a crude price of 85$/bbl, the gasoline price (excluding tax and duties) is ~ 44.6 Euro cents / litre
- A similar methodology can be conducted with diesel price

NB: 2010 average GBP:Euro exchange rate applied to return price in Euro cents/litre – www.oanda.com

Option 2 – 1st Generation Bioethanol

Key assumptions (illustrative only)

- Ethanol via saccharification / fermentation of wheat
- Production: 150,000 tonnes per year
- Capital cost: €120M
- Annual Operating cost (including feedstock): €123M
- Wheat: €150 / tonne
- Co-product (animal feedstock): 120% of wheat price

(Detail to be provided in Submission Form 4)

Sensitivity Analysis

- Define innovative project (Biomass to Liquids via gasification)
- Calculate relevant costs using gasoline and 1st generation bioethanol as reference plants
- Assess sensitivity of relevant costs to changes in key variables

Key Parameter	Sensitivity of relevant cost to: Gasoline reference	Bioethanol reference
Capital Cost	n.a.	low
O&M	n.a.	low
Wheat price	n.a.	high
Crude price	medium	n.a.

Conclusions biofuels

- MS may compare cost per unit energy of innovative project with gasoline price to determine relevant costs (modify Submission Form 4)
- Gasoline price more consistent across the EU
  - Level playing field when evaluating CPUP
  - Overcome challenge of conventional refinery cost structure
  - Similar approach used so far in ENV State aid guidelines
- Bioethanol costs more sensitive
  - Relevant costs are more sensitive to wheat price than crude price
  - Bioethanol capital costs more variable
- Projects likely to receive more financial support from NER 300 under gasoline price RefPlant

Conclusions bioenergy

- MS are responsible for defining the reference plant

- BIOa & BIOb: relevant costs calculated according to specific capital equipment
- MS may use the same reference plant for all bioenergy projects which produce electricity if appropriate
  - CCGT is the most favourable reference plant

- MS may use a single reference plant for all bioenergy projects which produce a biofuel if appropriate
- Based on our analysis, it appears that the gasoline or diesel price is the most favourable reference point

Q&A

SECTION 4:
EXCHANGE OF VIEWS - MS