



**“Preparing for the Hydrogen Economy by Using the Existing Natural Gas Network as a Catalyst”
Project Contract No. SES6/CT/2004/502661**

Life Cycle and Socio-Economic Assessment of the Natural Gas System in Transition to Hydrogen

Nigel Mortimer and Onemus Mwabonje (UK)

Kerry-Ann Adamson, Boris Heinz and Roland Monjau (DE)

Thomas Esdaile-Bouquet (BE)

Thomas Feck and Klaus Stolzenburg (DE)

Peter Helby (DK)

Eduardo João Silva and Clara Melo Santos (PT)





NATURALHY Project

- Use of **existing natural gas** network to transport hydrogen in a mixture
- Use of established **infrastructure asset**
- Partnership of **39** different organisations
- **European Commission** Integrated Project
- Total budget **€17.3 million**
- **5** year project, started May 2004
- Details in **Poster 686**





European Union Natural Gas Network



- Customers = **93,614,775**
- Transmission network length = **214,652 km**
- Distribution network length = **1,444,400 km**
 - Service line length = **51,739,401 km**



Technical Feasibility of Adding, Separating and Using Hydrogen

Safety (WP2):

- Acceptable risk = up to 20% H₂
- Acceptable explosion severity = 20% to 30% H₂

Durability (WP3) and Integrity (WP4):

- Older steel pipe strength = up to 50% H₂
- Life of plastic pipes = unaffected by H₂
- Domestic meters = unaffected by H₂

End Use (WP5) – Separation:

- Two-stage C/Pd membranes > 99.99% H₂ purity

End Use (WP5)– Mixtures in Appliances:

- Older appliances = up to 20% H₂
- Modern appliances = up to 50% H₂



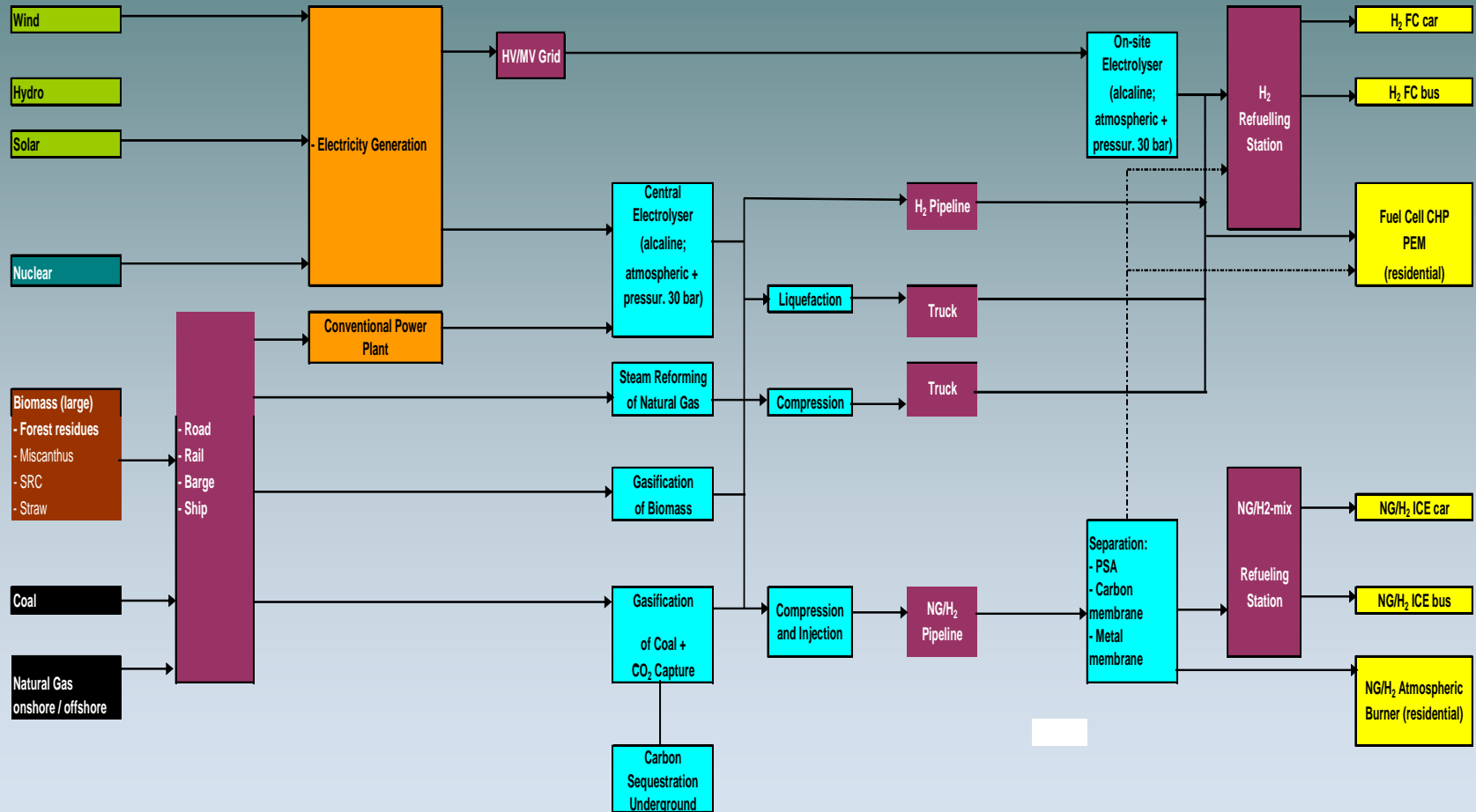


Costs and Benefits: Environmental, Employment and Economics

- Evaluation by MS Excel **workbooks**
- One workbook per technology calculates:
 - **primary energy**
 - **greenhouse gas emissions (CO₂, CH₄, N₂O)**
 - **air quality emissions (SO₂, NO_x, PM)**
 - **hydrogen**
 - **ionising radiation**
 - **jobs (direct and indirect)**
 - **costs (internal)**
- **Standard structure:**
 - **repetitive**
 - **transparent**



Natural Gas System in Transition to Hydrogen





Example Case Study: Baseline

- Transport requirement = 1.7×10^7 km/a
(**1,300 cars**)
- Heating requirement = 1.1×10^9 MJ/a
(**35 MW continuous**)
- Current emissions ~ **69,000 tonnes CO₂/a**



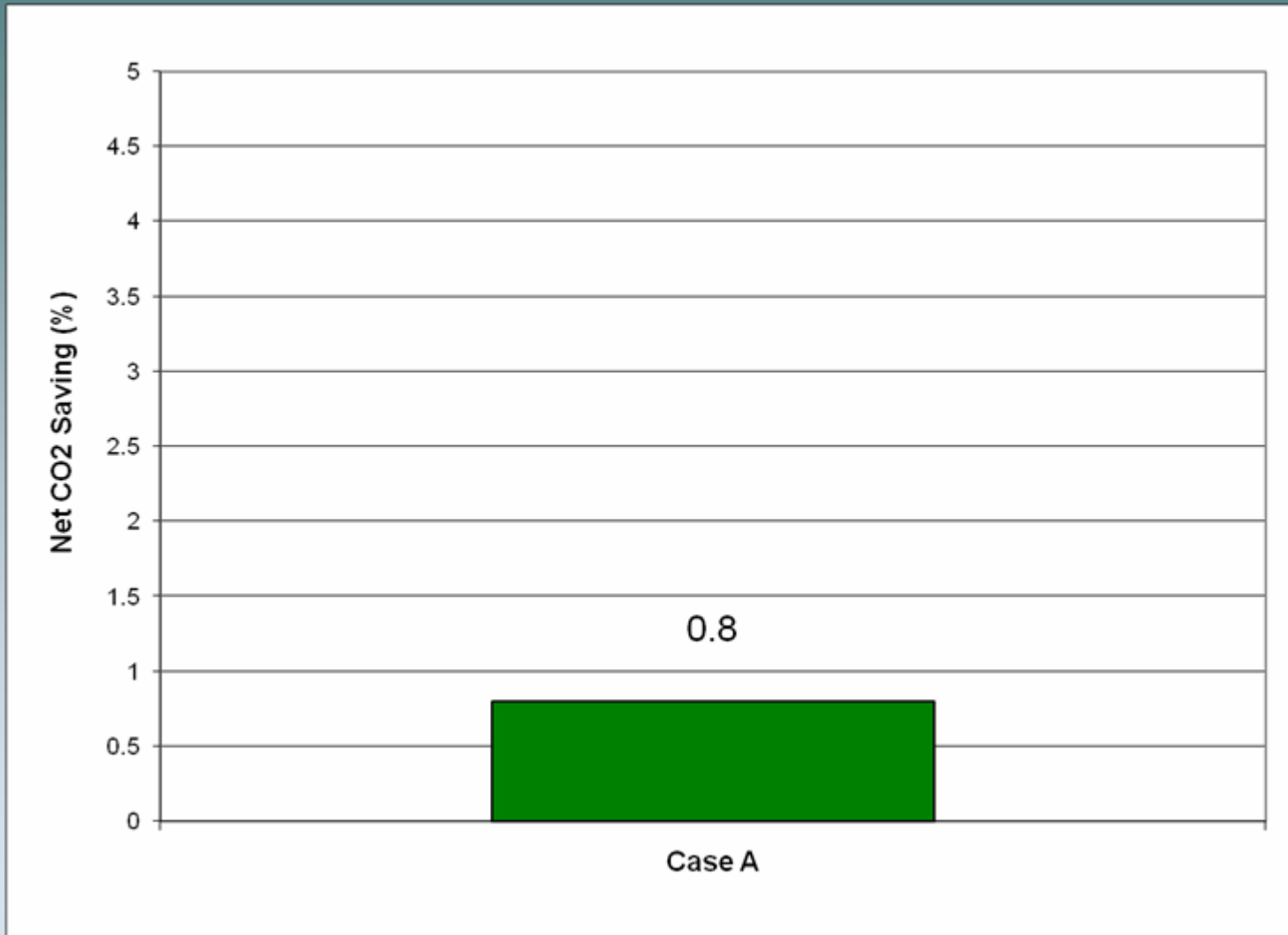


Example Case Study: Case A

- **10%** H₂ by volume with natural gas
- H₂ from **natural gas** by steam reforming with **no carbon capture and storage**
- Separation performance:
 - Efficiency = **44%**
 - Electrical input = **0.051 MJ/MJ H₂**
 - Electricity from **fossil fuels**



Example Case Study: Case A - Net Savings



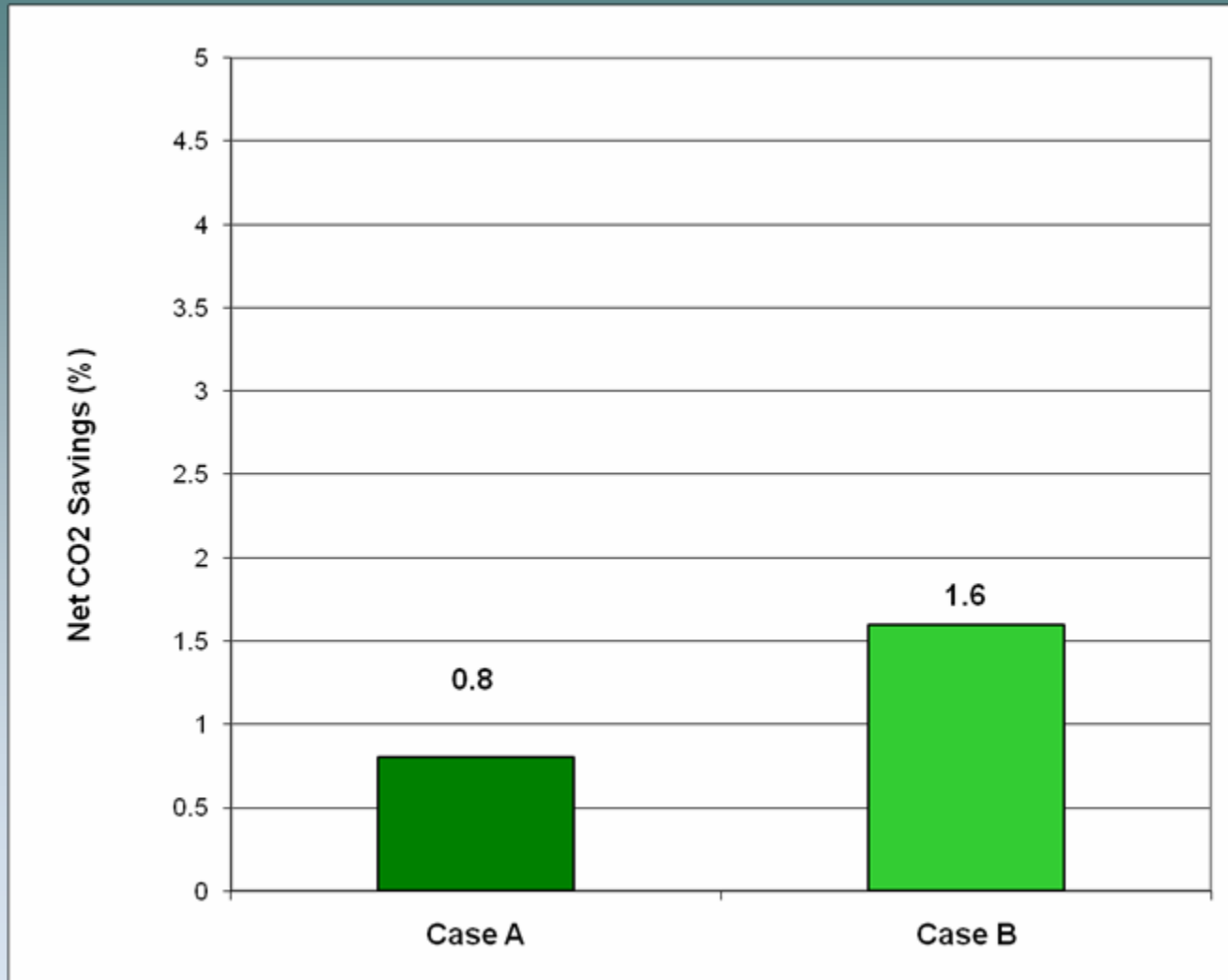


Example Case Study: Case B

- **10%** H₂ by volume with natural gas
- H₂ from **natural gas** by steam reforming with **no carbon capture and storage**
- Separation performance:
 - Efficiency = **80%**
 - Electrical input = **0.020 MJ/MJ H₂**
 - Electricity from **fossil fuels**



Example Case Study: Cases A and B - Net Savings



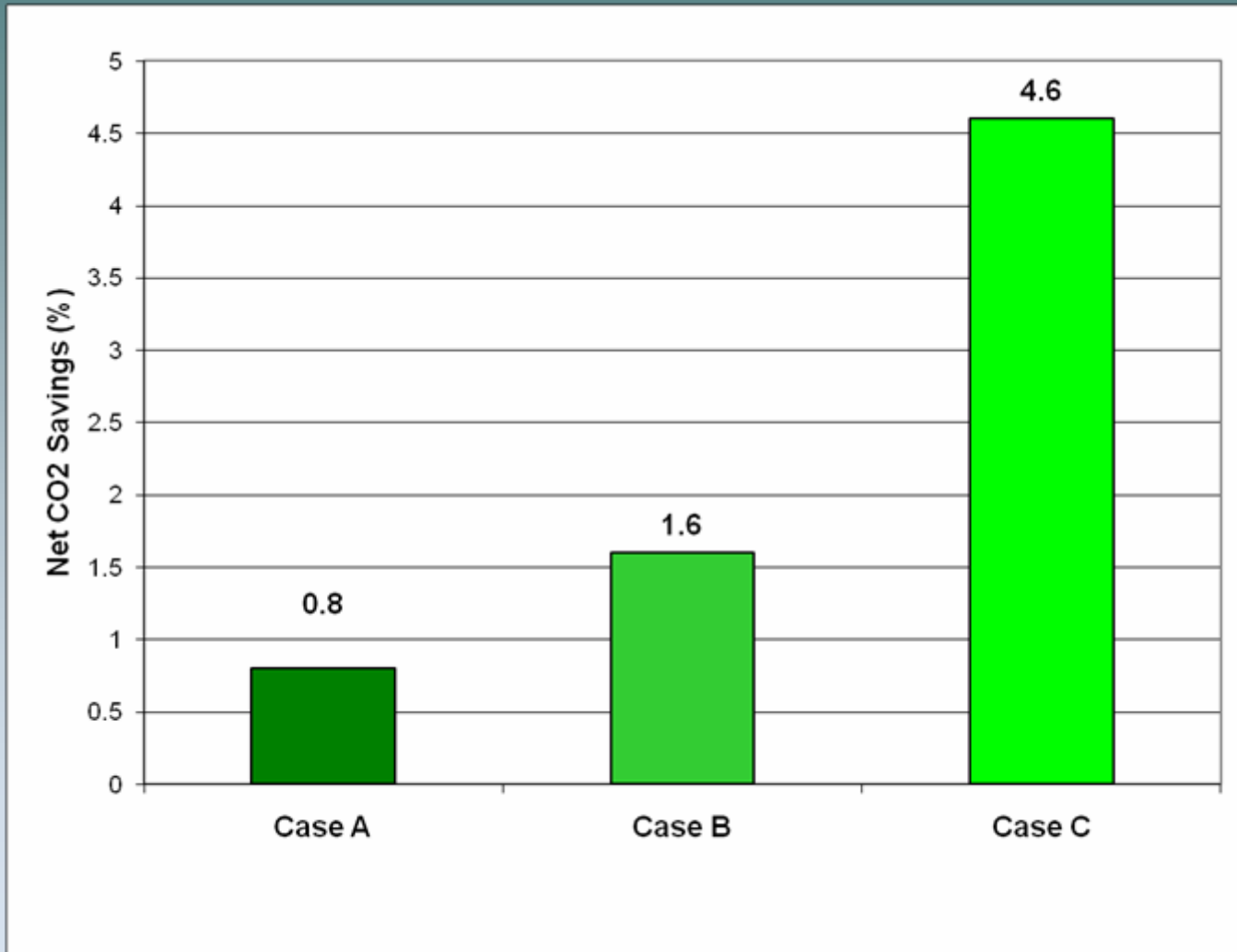


Example Case Study: Case C

- **10%** H₂ by volume with natural gas
- H₂ from **wind power** by **electrolysis**
- Separation performance:
 - Efficiency = **80%**
 - Electrical input = **0.020 MJ/MJ H₂**
 - Electricity from **wind power**



Example Case Study: Cases A, B and C - Net Savings



- Importance of **source of hydrogen**
- Importance of **separation technology performance**
- Significant **savings** from natural gas system in transition to hydrogen
- Need for **flexibility** and **transparency** in assessment



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Thank you for your attention

Dr. Nigel Mortimer

N.D.Mortimer@lboro.ac.uk

www.naturalhy.net

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