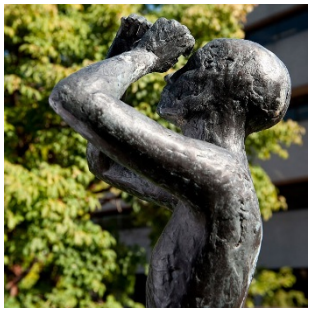

A multi-model approach to provide insight into energy efficiency gains in Industry

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A TRADITION OF INDEPENDENT THINKING

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Overview

- Motivation & Methodology
- Soft-Linking Approach
- New Data set (Applied to Ireland)
- Feedback between LEAP-IE and TIMES
- Initial Results

Motivation

- Historic lack of detailed data on Industry sector in Ireland.
  - Limited potential for evidence based policy.

- Method provides insights into energy end use in the industry sector while maintaining the best sources available for aggregate use i.e. Energy Balance for Ireland.

- Explore the potential energy savings contribution from Industry in the context of the whole energy system (multi-model approach).

Why Use Two Models?

TIMES

- Optimisation Model
- Least Cost Solution

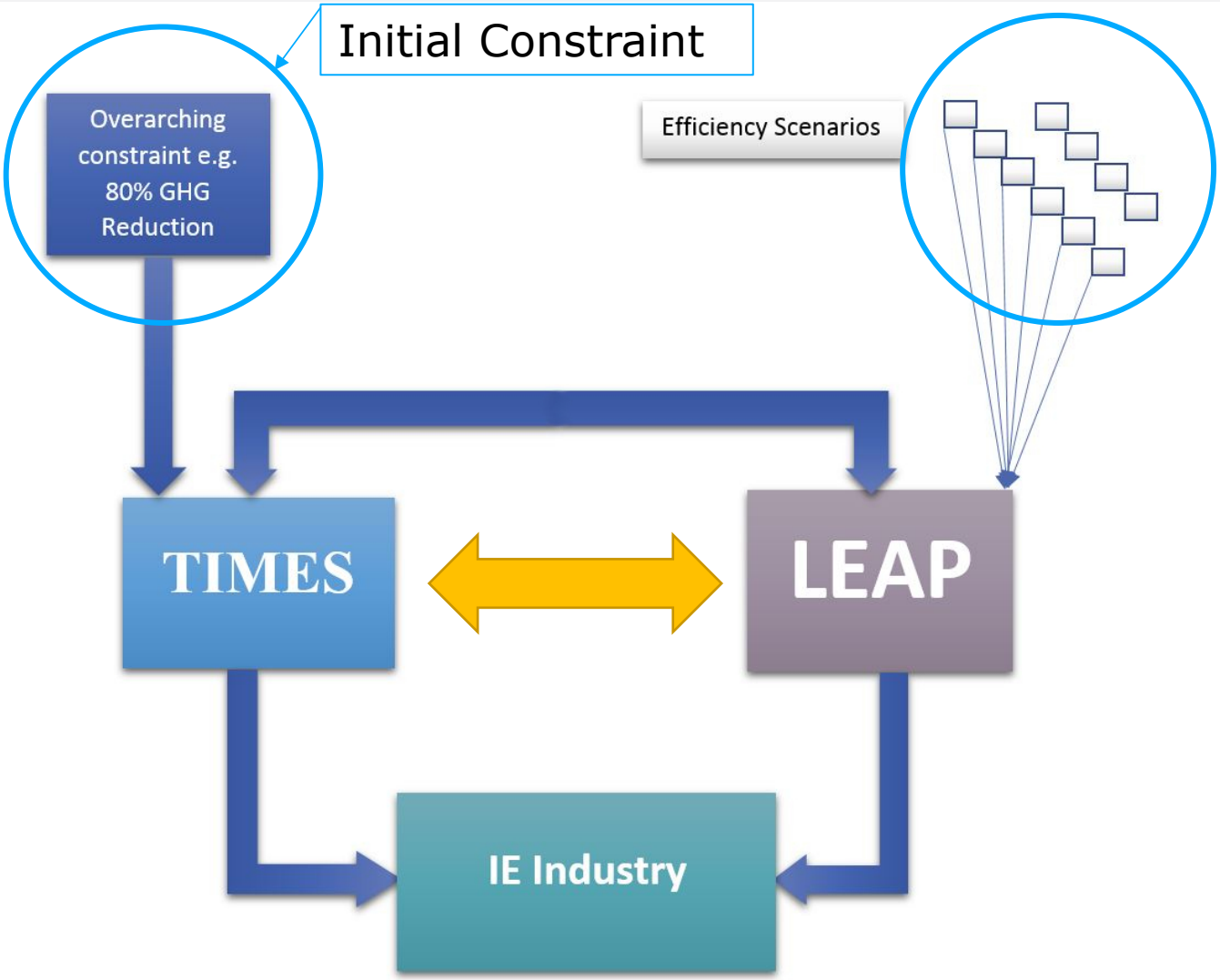
LEAP

- Simulation Model
- Impact of individual measures

What Questions can these models answer?

- Irish TIMES energy systems model
  - *What are the implications for the energy system and the economy of emissions reduction ambition levels?*
- Irish LEAP model
  - *What emissions reductions will specific policy measures deliver and how effective will they be?*

Soft-Linking TIMES & LEAP



Matching DECC End Use with IE Energy Balance

UK Stats-Total

Process	% Split	Electricity	Natural Gas	Oil	Solid Fuel	Total
HTP	0%	0	0	0	0	0
LTP	62%	328	1317	100	23	1768
Drying & Seperation	7%	38	150	11	3	202
Motors	9%	245	0	0	0	245
Compressed Air	0%	0	0	0	0	0
Lighting	0%	0	0	0	0	0
Refrigeration	9%	256	0	0	0	256
Space Heating	0%	0	0	0	0	0
Other	14%	74	298	23	5	401
						2872

IE Estimated % Split

Process	% Split	Electricity	Natural Gas	Oil	Solid Fuel	Total
HTP	0%	0	0	0	0	0
LTP	62%	78	71	85	34	268
Drying & Seperation	7%	6	23	2	0	31
Motors	9%	37	0	0	0	37
Compressed Air	0%	0	0	0	0	0
Lighting	0%	0	0	0	0	0
Refrigeration	9%	39	0	0	0	39
Space Heating	0%	0	0	0	0	0
Other	14%	11	0	49	0	61
						435

- IE Balance is normalised to UK end use split while maintaining total final consumption with Energy Balance (ktoe)
- Final Consumption by NACE & SIC codes consistent.

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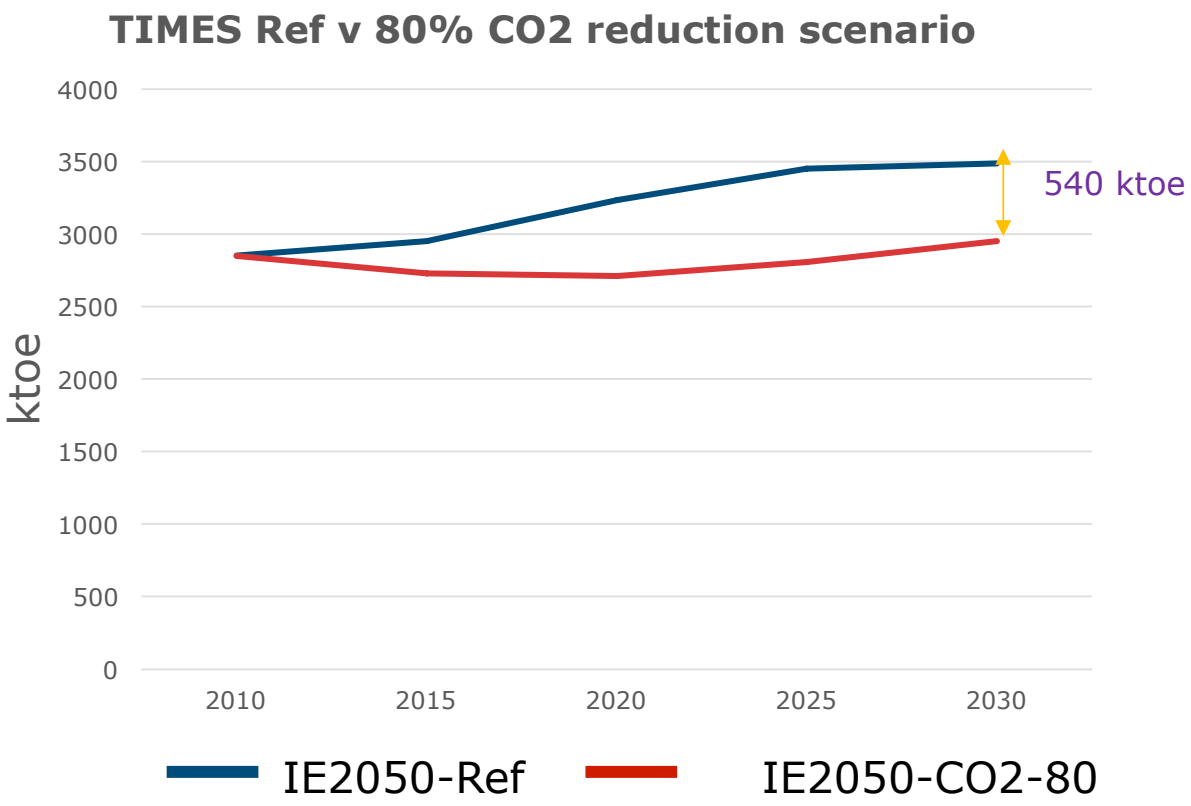
LEAP Scenarios

- 24 scenarios -investigating energy reduction potential by end use.
- Low/ Medium & High Efficiency Scenarios for each end use. (Shown Below)
- Scenarios were then combined to approximate energy reduction witnessed in TIMES CO2 80% reduction scenario. (Highlighted Below).
  - High Temperature Processes (2%, 10%, 20%)
  - Low Temperature Processes (2%,10%,20%)
  - Motors (2%, 10%, 20%)
  - Compressed Air (10%, 20%, 30%)
  - Lighting (3%, 10%, 19%)
  - Refrigeration (8%, 16%, 24%)
  - Space Heating (2%, 7%, 14%)

2030 Results (TIMES)

Ref Scenario



Key Figures

- Overall consumption reduced by 540 ktoe (2030) reaching 2948 ktoe in 2030.
- This represents a growth of just 8% between 2015 & 2030 in the 80% CO2 reduction scenario

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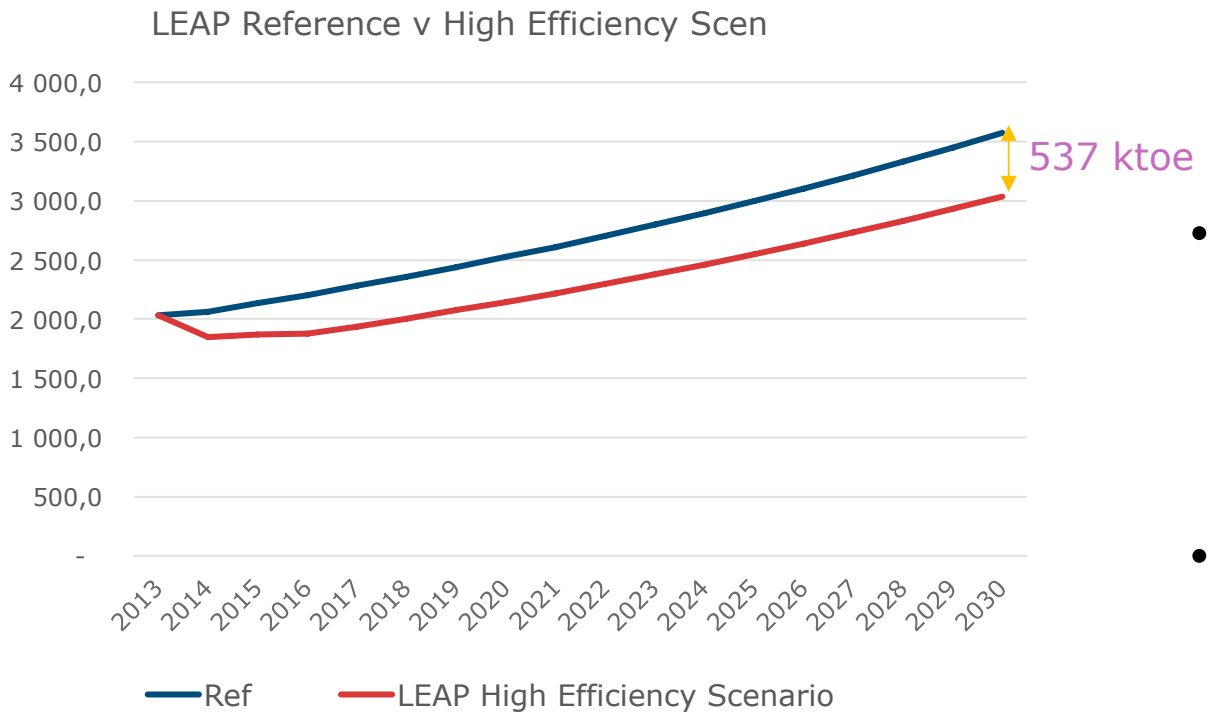
2030 Results (LEAP)

Efficiency (+) Scenario



Key Figures

- Consumption reduced by 537 ktoe in 2030 rel. Ref scenario.
- Total growth 65 % between 2015 & 2030, reaching approx. 3039 ktoe consumption (2030)
- % Diff (2030) Leap v TIMES ≈ 3%

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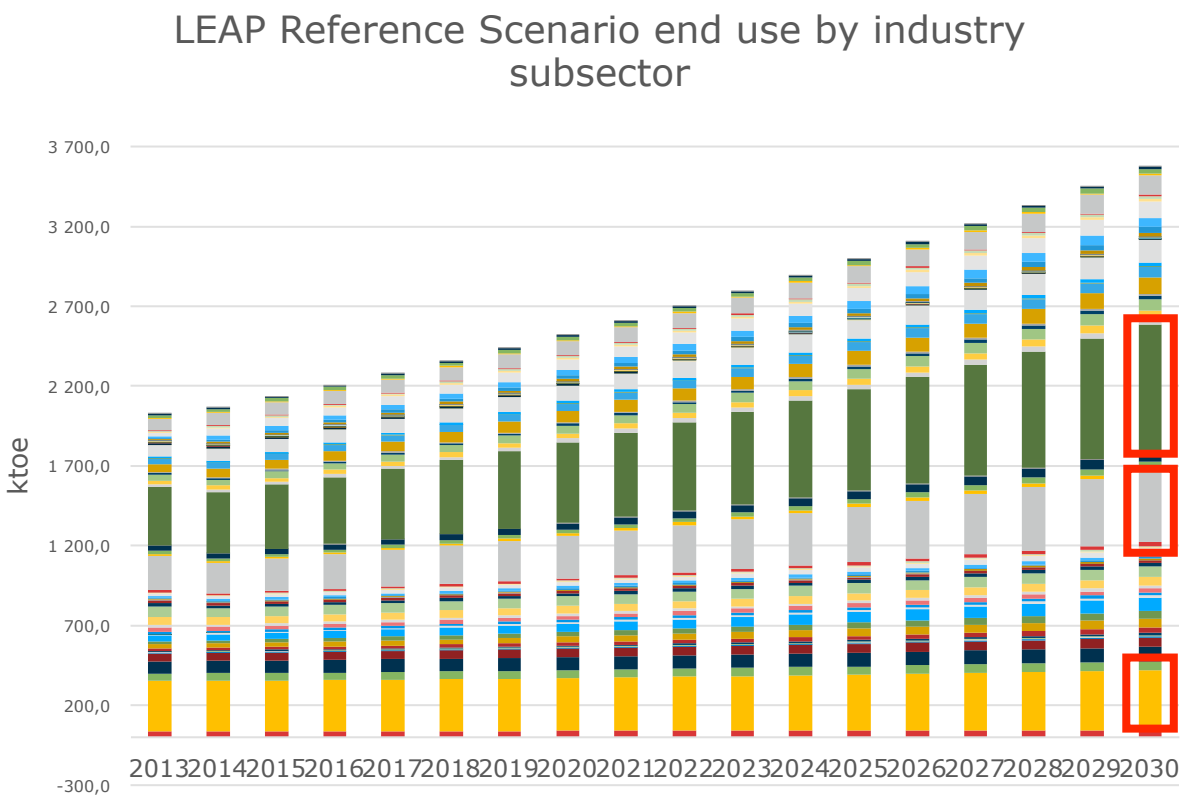
2030 Results (LEAP)

Reference Scen.



Key Figures

- Highest consumption by End use: LTP in Food & Beverages, HTP in Basic Metals & Non metallic minerals
- Accounts for 45% of final consumption in 2030.

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Conclusions & Next Steps

- Merged data set provided useful insights into industry sector.
- Energy reduction targets from TIMES achieved in LEAP – further work to investigate required effort to implement these measures required within LEAP.
- Derive energy efficiency policy measures in Industry sector based on cost optimal energy system wide targets.
  - HTP: NACE 28 Basic Metals/ NACE 23 Non-metallic minerals
  - LTP: NACE 10-11 Food & Beverages
- Utilise CSO Business Energy End Use survey to gain further insights into industrial energy use.
- Complete new Irish TIMES model with modified industry sector definitions and compare results

Thank you

Go Raibh Maith Agat

Danke

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Matching Data Sets

- Effectively matching data sets between DECC Data & IE Energy Balance by adhering to following rules:

1. Only Electricity as fuel for Motors, Compressed Air, Lighting, Refrigeration.

2. Priority given to fuel switching in other category to avoid biased results indicating any particular end use.

3. Fuel switching then occurs in Space Heating given the large number of heating alternative e.g. Coal, NG, Elec, Oil

4. All remaining fuels switched between HTP, LTP and Drying & Separation to align energy consumption with Irelands Energy Balance.

General method shown on the following page

LEAP_IE Industry structure

LEAP Industry Structure

- Key Assumptions
- Effects
- Demand
  - Transport
  - Services
  - Agriculture
  - Industry
    - NACE 5_9 Non Energy Mining
    - NACE 10_11 Food
    - NACE 13_14 Textiles
    - NACE 16_Wood
    - NACE 17_18 Paper Printing
    - NACE 20_21 Chemicals
    - NACE 22_Rubber Plastics
    - NACE 23_Nonmetalic Minerals
    - NACE 24_25 Basic Metals
    - NACE 28_Machinery Equipment
    - NACE 26_27 Electrical Optical
    - NACE 29_30 Transport Equipment
    - NACE 31_33_12_15 Other
  - Residential
- Transformation
- Resources

LEAP IND End Use & Fuel

- Key Assumptions
- Effects
- Demand
  - Transport
  - Services
  - Agriculture
  - Industry
    - NACE 5_9 Non Energy Mining
      - HTP
        - Electricity
        - Natural Gas
        - Oil
        - Coal Bituminous
        - Biomass
      - LTP
      - Drying and Seperation
      - Motors
      -
      - Lighting
      - Refrigeration
      - Space Heating
      - Other

LEAP_IE, New Data: Purpose & Benefit

- LEAP IE modified to incorporate DECC data on Industry End Use.
  - End-Use data for Industry in Ireland is not available
  - Looking for insights to Industry sector energy efficiency measures
- 8 Distinct End-Uses:
  - High Temperature Processes (HTP)
  - Low Temperature Processes (LTP)
  - Drying & Separation
  - Motors
  - Compressed Air
  - Lighting
  - Refrigeration
  - Space Heating
  - Other
- Data set matching process ensures consistency with IE Energy Balance for Ireland & % Split of End use within DECC data (2013)

Methodology

- Soft-Linking of energy systems models.(TIMES & LEAP-IE)
- TIMES used to identify **cost optimal pathways** to achieve overall emission reduction targets for the whole energy system.
- LEAP used to simulate **sectoral energy pathways** in higher temporal and technology resolution.
- New Data sets leveraged to provide more detailed insights into Ireland's Industry sector using LEAP_IE
- Feedback between both models provides insights on feasibility of different energy efficiency scenarios.