World modelling with TIAM: first experience

1. ETSAP modelling tools
2. TIAM model study
3. Further model usage

Greece, 2011
1. ETSAP modelling tools
( Energy Technology Systems Analysis Program )
2. TIAM -> input data

Fossil fuels supply

Data is set by region, types and cost steps for oil, gas and coal.

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Source: ETSAP-TIAM - some details on model and database
2. TIAM -> input data

World supply curve for gas
2. TIAM -> input data

World supply curve for oil

- $/boe
- Billion tonnes of oil equivalent (1000 mtoe)
2. TIAM -> input data

World supply curve for coal
## 2. TIAM -> input data
### Inter-regional connections

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2. TIAM -> input data

Inter-regional gas pipeline transport cost, $ 2010/thousand cubic meters

New liquefaction projects all over the world:
- Time life 50 years;
- Liquefaction tariff 244.8 $ 2010/kcm
2. TIAM -> base case results
TPES, mtoe
2. TIAM -> base case results

World TPES base case results in comparison with IEA WEO 2010 projections

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* - Nearly 3-time difference in nuclear energy can be explained by the IEA statistical conversion factor for nuclear energy (33%)
2. TIAM -> base case results

World TFC demand in comparison with the IEA WEO 2010 projections

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| Industry               | 2,216     | 2,098         | 3,385     | 2,967-3,132 | 4,395     | 3,076-3,512 |
| Coal                   | 478       | 518           | 989       | 811-876    | 1,284     | 750-937     |
| Oil                    | 354       | 327           | 312       | 351-380    | 392       | 321-384     |
| Gas                    | 571       | 425           | 1,098     | 556-587    | 1,578     | 592-658     |
| Electricity            | 501       | 532           | 676       | 857-908    | 826       | 971-1,115   |
| Heat                   | 85        | 115           | 39        | 128-134    | 21        | 120-141     |
| Biomass                | 219       | 177           | 264       | 246-264    | 291       | 276-321     |
| Other ren              | 7         | 0             | 5         | 1-1        | 5         | 1-1         |

| Transport              | 2,069     | 2,175         | 2,286     | 2,588-2,710 | 2,746     | 2,770-3,182 |
| Coal                   | 4         | 4             | 12        | -          | 21        | -           |
| Oil                    | 2,026     | 2,060         | 2,068     | 2,336-2,483 | 2,196     | 2,292-2,891 |
| Gas                    | 8         | 70            | 122       | -          | 225       | -           |
| Electricity            | 19        | 22            | 23        | 34-38      | 27        | 46-80       |
| Heat                   | 0         | 0             | 0         | -          | 0         | -           |
| Biomass                | 12        | 19            | 60        | 107-122    | 277       | 142-283     |
| Other ren              | 0         | 0             | 0         | -          | 0         | -           |

| Other                  | 2,749     | 2,884         | 3,190     | 4,224-4,382 | 3,742     | 4,411-4,850 |
| Coal                   | 99        | 114           | 45        | -          | 71        | -           |
| Oil                    | 460       | 489           | 405       | 1,064-1,123 | 471       | 1,037-1,163 |
| Gas                    | 574       | 597           | 810       | -          | 877       | -           |
| Electricity            | 688       | 739           | 787       | 1,038-1,097 | 1,020     | 1,179-1,387 |
| Heat                   | 125       | 153           | 159       | -          | 181       | -           |
| Biomass                | 796       | 790           | 930       | 881-899    | 1,037     | 880-939     |
| Other ren              | 7         | 10            | 54        | -          | 85        | -           |
2. TIAM -> base case results

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0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
2. TIAM -> base case results

Dual prices for fossil fuels (gas, oil and coal)

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<td>- Natural gas</td>
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<td>- Hard coal</td>
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<td>- Crude oil</td>
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2. TIAM -> base case results
Gas export from FSU, bcm

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By directions

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**ERI RAS**
3. Further model usage -> Scenario calculation

Pipeline gas export from FSU, bcm by scenarios:
- ET_Ref – base case, calculated by ERI RAS
- ET_Ref_1303 – base case, downloaded from kanors
- ET_Ref_FSU_CHI_BND – ERI RAS case with the modified export capacity and costs data

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Due to the lack of pipeline gas from the FSU, China has moved to import LNG from the Middle East. Such «unreal» import and export results are possible because of the far too large world fossil fuels supply capabilities used in the TIAM model.
Alexander Goryachev,
Modelling expert

Thanks for attention

Energy Research Institute of the Russian Academy of Sciences (ERIRAS)