Panel Discussion on Energy Efficiency

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Abstract The session on energy efficiency had no formal presentations and was organized as a panel discussion with four panelists. It was concluded that energy efficiency and saving measures on the short term is the most effective way to contribute to a sustainable energy system. Measures to improve and encourage energy efficiency should be implemented at all levels; municipal/local, national and super-national. Prices can be an effective instrument but need to be combined with systemic level measures. The transport sector was identified as the one with largest near future potential for increased energy efficiency. Agriculture and food is also an area with very large energy consumption and large potential for increased energy efficiency. The global population issue is yet another relevant, challenging and complex issue. It was noted that energy audits for end users in business and society increase awareness and insights into what they pay for, and they are likely to promote actions to save energy. Many measures are believed to suffer from Jevins's paradox, i.e., that more efficient use of energy just leads to more energy consumption somewhere else. Many examples were given, however, where this does not happen. Another point put forward was that measures to make the energy system more efficient do not only mean constraints and regulations but also create great opportunities for market actors and societies.

Keywords Energy · Efficiency · Transport · Jevons paradox · Population · International collaboration

The session on energy efficiency at the Royal Swedish Academy's Energy committee's ENERGY 2050 symposium had no formal presentations and was organized as a panel discussion with four panelists, Ernst Ulrich von

Weizsäcker, Bernie Bulkin, Ola Alterå and Tomas Kåberger. The session was chaired by Brian Heap and Bengt Kasemo. At the end of the session, the discussion was open to the audience to participate with questions.

The panel discussion started with each person giving a 7 min presentation about what was regarded as particularly important issues for energy efficiency. The presentation was followed by a 1-min summary of what was perceived as particularly important.

PANEL DISCUSSION

Bengt Kasemo said that the topic is often perceived as less 'sexy' than inventing new instruments to solve the world's future energy needs. In the short run, energy efficiency may, however, turn out to be the most profitable and even the most effective way to preserve energy resources, since there is no obvious 'quick fix' or 'silver bullet' just around the corner. Two important questions are: *Where* can efficiencies be improved and *how* can they be achieved?

7-min Presentations

Energy supply and demand are the two topics that occupy most attention, but energy efficiency is the most successful route to immediate savings (Bernie Bulkin). It is the greatest and most effective opportunity we have in a drive towards sustainable development. Reduction of greenhouse gases and the decarbonisation of electricity by the electrification of road transport are closely related and are two of the most promising ways to improve energy efficiency. If improvement in energy efficiency has such a potential for saving resources why do governments and policy makers fail to pursue the issue aggressively?

Jevon's paradox still drives the government thinking. Formulated in 1856, the paradox is derived from the idea that if we use energy more efficiently it will not give returns but rather increased consumption. When the steam engine was invented an increased demand for coal and decreased prices occurred as a result of rising consumption. This produced a rebound effect, as the increase in consumption exceeded the efficiency gains. A rebound of more than 100% meant consumption outstripped efficiency gains. In the 1970s, efficiency gains were achieved for refrigerators in the USA. Over a 30-year period, the energy per unit decreased by 75%. Financial savings were therefore available for other consumer activities arising from a rebound effect. However, rebound need not happen if it is regulated by appropriate government policy. In the UK, labelling of domestic appliances regarding their energy usage was put in place and a rebound did not occur. In this latter case, few consumers knew how much they were consuming so that ignorance precluded any rebound effect. Moreover, when such information is available to consumers they do not necessarily increase consumption. Hybrid cars provide real-time information about fuel efficiency which has an effect on driving habits so that drivers try to achieve even greater efficiency savings. There is no evidence that it increases driving. LED lighting greatly reduces energy consumption but it does not produce greater lighting.

Policy makers and governments are reluctant to move away from their preoccupation with Jevon's paradox and to focus on energy efficiency through greater savings by technological or behavioural change derived from the dated view that 'we tried it in the past and it didn't work'. Instead, they should be made more conscious of the power and magnitude of efficiency savings, the housing stock should be better equipped to make efficiency gains, and customers should be given more information about their energy consumption. Reduced consumption should be incentivised to lock-in real energy gains. This process of decoupling offers the biggest prize with which to address climate change immediately.

Tomas Kåberger thought energy efficiency really was 'sexy' precisely because it could be profitable. The McKinsey reports showed where and how efficiency gains could be made. In Sweden, financial savings accrued from systematic measures such as tax rebates and no subsidies. Investments of 100 million euros in Sweden's Programme for Energy Efficiency have reduced energy consumption by 1 TWh per annum. Volvo has reduced energy costs in some of their production line by 50% taking multiple, simple and obvious steps to reduce consumption (e.g. energy-hungry heaters and ventilation systems switched off when not needed). Such initiatives increase the nation's competitiveness within and beyond Europe. Even if there is

a rebound effect—Kåberger was unconcerned about this—energy efficiency is what matters most.

Ernst Ulrich von Weizsäcker presented numerous examples of energy savings, expressed in terms of factor savings. He believes energy efficiency is still grossly undervalued. We need a fourfold or fivefold increase in energy productivity, an increase of 300 or 400%. How do we get there? Three options exist, *reduced carbon intensity* of energy, *reduced energy intensity* of wealth, or *reduced wealth*. Conventional thinking involves reductions in the order of 70, 15, and 15%, respectively, for these three options. In reality, this is not going to happen; the amount of renewable energy is limited, nuclear energy presents serious problems in terms of speed of building power plants and disposal of waste, and carbon capture and storage has not even been demonstrated to work. The alternative suggestion would be to aim for 30, 65, and 5% reductions, respectively. This can be achieved through efficiency changes in mobility, housing, food, lighting and industrial goods and services. von Weizsäcker's revolutionary preference is for a 65% reduction in energy intensity of wealth.

Colleagues in the Rocky Mountain Institute in the USA have shown how substantial energy efficiencies could be affected by improvements in car efficiency, housing construction and refurbishment, and lighting. Energy savings up to tenfold have been achieved. von Weizsäcker emphasised the energy demands of the energy-demanding cement industry, and how major savings might emerge in China by reformulation using fly-ash from coal-fired power plants (Factor 5). Agriculture continues to be a source of concern with its current net energy consumption when this is compared to its energy production 150 years ago. Distribution and product networks have been identified as sources of energy waste since transportation of components of food products around the world compound inefficiencies, as in the case of strawberry yoghurt in Germany (though this may be case specific). Video-conferencing is another case where the potential for significant reductions in energy usage exist from savings in intercontinental air travel.

von Weizsäcker pointed to the fact that progress has occurred as a result of waves of technological innovations, but these advances do not reach the market quickly enough to have an immediate effect. Energy has become cheaper and is still too cheap. Concern was expressed that societies should increase energy prices in proportion to energy productivity gains, thereby avoiding social hardship and capital destruction. He added that the draft document for Copenhagen centered too much on innovation and did not mention the topic of energy efficiency and potential savings.

Ola Alterå spoke about the policy opportunities and the role of Sweden in its Presidency of the European Union 2009. Energy efficiency is a central pillar in the transition

to an eco-efficient economy and is a priority for the Swedish EU Presidency. Faced with the prospects of climate change and economic crisis, the need to build a more sustainable future is paramount. Sweden focuses on how to stimulate energy efficiency in all sectors—private companies, public authorities and households—by specific and general policy measures.

Decoupling energy usage and economic growth was addressed by measures aimed to identify the right pricing and tax structures and thereby provide a more stable situation which would be attractive to investors. This gives consumers and companies the right price signals, e.g. that it is profitable to switch to renewables and save energy. The carbon tax has been used to shift space heating from fossil fuels to district heating based on renewable energy and municipal waste. From 1990 to 2008, Sweden has reduced GHG emissions (9%) while GDP has grown by 48%. Energy intensity of the economy has decreased by 27% showing that economic growth, energy efficiency and reduced emissions can go hand-in-hand. Since 1990, there has been a 90% reduction in the use of fossil fuels with a switch to increased bioenergy for heating. Alterå reiterated the importance of providing information to end-users. He also spoke of the need for energy audits, particularly in small businesses and local municipalities, which help to make policy efficiency a key topic. This facilitates the speed up of what is otherwise a slow process, by increasing awareness among companies and households of possible energy efficiency measures. For the period 2010–2012, the Swedish government has invested over 160 million Euros in measures to promote more efficient energy use in industry, agriculture and forestry, construction, transport, households and the public sector.

The Panel's 1-min Summaries

Bulkin chose cars, trucks and buses, i.e. transportation on roads, as the areas where the greatest improvements could be made in the efficiency.

von Weizsäcker chose to focus on getting the prices right because of the effect on behaviour.

Kåberger said it needed more than prices; exercising intelligence to select the most effective opportunities was also a key, e.g. heat pumps in district heating networks.

Alterå observed that attention to the whole system was essential rather than selecting a single part.

Questions from the Audience and Answers from the Panel

Turning to Q&A, the Panel was asked to speak further about agriculture, which was 'eating fossil fuel' to produce food. Problems with the CAP were highlighted and the

unequal range of energy intensity across the EU (Denmark 1.0; Bulgaria and Romania 15.0).

Energy savings that could be achieved via improved transmission grids were mentioned, but regional interests and vested interests are great impediments. Cross-sectoral policies are urgently required and this is an area of serious policy failure. Nordic cooperation has shown a way forward. An ambitious programme to produce a pan-European grid that incorporates renewable energy sources, HV-DC cabling and modern computer switching mechanisms should be adopted as an EU-wide initiative. The presentation earlier in this meeting of work on concentrating solar power (CSP) has shown a way forward. The intention of the EU to appoint a Chief Scientific Adviser is an important signal that science and technology are of crucial importance for the future of the Union.

The point was made that many of the technologies described are still far from the limits imposed by the second law of thermodynamics so that efficiency gains could be widespread. Market failure is a particular problem in the aviation industry where efficiency gains of only 1.5% have been achieved when market growth was 4% per annum. The Panel expressed the view that prohibition of taxation of aviation fuel is an outdated concept (dating back to Lindbergh). Similar comments were made on sea transport. The construction of a third runway at Arlanda, Stockholm has shown it was possible to carry out such developments within strict GHG controls using measures other than targeting aircraft (e.g. electric trains, taxis running on biofuel, etc.). Another option is to move people onto trains instead of planes and develop a high speed intercity network.

Population growth, the elephant in the room, was raised and considered in the context of the link between energy and poverty and the importance of sustainable energy sources (e.g. solar). A comment was made that the experience of China has shown that it could be a public good to decrease population growth. Migration is a cause for concern as it has been the major source of population growth in the USA. A total of 50 million migrants in the USA are equivalent to 250 million people in China with respect to their planetary impact on energy use.

In conclusion, Kasemo said that the highlights for him from the lively discussion had been the clear promise and potential of significant efficiency gains in the transport sector, the importance of pricing mechanisms in combination with systemic actions to achieve efficiencies, the need for local level efficiency gains, e.g. by audits to individuals, business and municipalities, and the concern about the energy costs of food production.

Heap identified two points: first, much had been said about scientific and technological fixes but economics, personal behaviour and value systems would be ignored at our peril. What people really value was deeply important if

we were to make real energy efficiency gains from behavioural changes. Second, the pessimism about international Summits derives from the fact that they often end up with competitive self-interested parties competing rather than co-operating with each other for the common good. It may be that Copenhagen targets for GHGs would not be fixed or met. Adaptation to climate change would then prove to be the highest priority. Efficient use of resources would then become an even more pressing objective.

SUMMARY

The main conclusions of the discussion were:

- Energy efficiency and savings measures were concluded to be the most effective way in the short term to contribute to a sustainable energy system.
- Optimal utilization of energy and the energy mix will be very important. Electricity will increase in relative importance in the future energy mix.
- Progress in energy efficiency should occur at all levels; individuals, municipal/local, national and super-national with a sound balance and constructive connections between them.
- There is no simple solution, e.g. technology fix. A combination of measures is needed at the technology–policy–economy–market–systems levels with an appropriate coupling and balance between them.
- Prices can be effective but need to be combined with systems level measures.
- Current behaviour and value frames are important conserving components, acting as barriers towards desired change.
- The transport sector was put forward as that with largest near-future potential for increased energy efficiency.
- Energy audits for end-users in business and society increases awareness and insights into what they pay for,

and are likely to raise willingness to take actions to save energy.

- Agriculture and food is an area with very large energy consumption and large potential for increased energy efficiency.
- Many measures are believed to suffer from the so called Jevin's paradox, meaning, in the present context, that saved energy and more efficient use of energy, just leads to more energy consumption somewhere else. Many examples were given where this does not happen and where the measures taken result in negative cost.
- The need for measures to make the energy system more efficient does not only mean constraints and regulations but also great opportunities for market actors and societies.
- The global population issue is another relevant and complex issue in the context of energy efficiency. Of special importance is a necessary increase of efficient agriculture and increased water irrigation.

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Brian Heap is President-elect, European Academies Science Advisory Council, and Honorary Fellow, St. Edmund's College, Cambridge. He was Vice-President and Foreign Secretary of the Royal Society, and served on the Nuffield Council on Bioethics, the Expert Group on Cloning, and the EU President's Advisory Group on Biotechnology.

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