



The future is looking musical: WEC Scenarios to 2050

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Secure, reliable, affordable, clean and socially equal energy supply is fundamental to global economic growth and human development. Future energy supply and demand, future environmental and social contexts are subject to a knot of uncertainties which are difficult to predict, such as the global economic context, technical innovations and geopolitics. In a world becoming more global, where new technologies foster ever quicker innovations and demand or behavioural responses, the task of predicting the future becomes harder.

WEC World Energy Scenarios to 2050 are based on a unique and original bottom-up approach, building on the extended global network of WEC's 93 member committees and 3,000 member organisations. WEC Energy Scenarios were built through numerous workshops gathering key energy stakeholders around the world and thus benefit from a truly regional approach which enables them to deliver regionally contrasted trajectories and a series of eight regional scenarios. The WEC scenarios are exploratory, in that we have not set a predetermined endpoint such as a specific target for atmospheric CO₂ levels.

We have adopted a musical theme for our Scenarios. We have taken two pathways forward, which we have named Jazz and Symphony, and we have worked out where they might lead at a global and regional level. They are meant to be credible rather than aspirational: what we think could happen, not what we would like to happen. The Citizen plays a key role in both scenarios.

In Jazz, people are consumers, driving a scenario in which consumers make the choices in a liberal, free-trade environment. Jazz is a style of music characterised by a strong but flexible rhythmic structure with solo and ensemble improvisations on basic tunes and chord patterns. In Jazz, musicians have freedom to take the lead and improvise; others in the band will often follow. As an energy scenario, Jazz has a focus on energy equity, with priority given to achieving individual access and affordability of energy through economic growth.

In Symphony, people are voters, influencing governments worldwide to strive for sustainable development. A Symphony is a complex piece of music with a fixed structure composed to be played by a Symphony Orchestra. The Orchestra will have a conductor, with each member having a specific role to play and score to follow. As an energy scenario, Symphony has a focus on achieving environmental sustainability through internationally coordinated policies and practices.

Unlike some other scenarios, we have not been transfixed by global CO₂ levels. We have developed a metric based on the WEC Trilemma goals, giving equal consideration to energy equity (access and affordability) and to energy security, as we do to environmental sustainability.

The project has involved working closely with our partner the Paul Scherrer Institute (PSI) which we entrusted with the complex modelling task of putting numbers on our scenarios. We debated long and hard how the key input parameters, GDP growth and the price of carbon, would progress in the two scenarios and across the regions. Part of this discussion was the recognition of the difference between the cost of carbon – the technological avoidance cost of CO₂ emissions, and the price of carbon – what society would be prepared to pay to reduce CO₂ emissions.

Global energy consumption will continue to rise, but at a much lower rate than in previous decades. We estimate that global energy supply will increase by 60 per cent in Jazz and 27 per cent in Symphony. Meeting both global and regional energy demand will be a challenge. In Symphony, we will see a larger switch to electricity and a greater improvement in energy efficiency. We will still be dependent on fossil fuels in both scenarios, but in Symphony there will be a greater uptake of renewables, especially solar, which will begin to overtake hydro by 2050.

Future economic growth shifts from developed countries to developing and transition economies, in particular in Asia. Asia, of all the eight regions considered in this scenario study, will be the region that can be characterised by highest economic growth, both in relative and absolute terms. By 2050, both for Jazz and Symphony, nearly half of all economic growth will occur in Asia and its three sub-regions: Central and South Asia, East Asia and Southeast Asia and Pacific.

Jazz and Symphony score well on Energy Security. Symphony makes use of a wider diversity of energy resource types, and has government-promoted investment in infrastructure. In Jazz there is higher energy production and a greater trading and diversity of international fossil energy suppliers.

For Energy Sustainability and Environmental Impact mitigation there is a clear differentiation. In Jazz, CO₂ emissions only level out at the end of the period; the world continues to depend on fossil fuels and will have to focus on adaptation to climate change. In Symphony, CO₂ emissions begin to drop before 2030 and we get close to achieving

the 450ppm atmospheric stabilisation level for CO₂. Some would say this is still not enough and there is room for further improvements, but in Symphony we do see a big increase in renewables especially solar, wide adoption of Carbon Capture and Storage, and progress with nuclear.

There is a price in terms of economic growth and hence energy equity, access and affordability. Energy equity progresses better in Jazz. More people are able to afford more energy because the global market leads to higher GDP growth and there is almost universal access to electricity in all the WEC regions except sub-Saharan Africa. Energy equity is less in Symphony because there are inevitably interventions restricting GDP growth. In the Symphony scenario, funds directed into low carbon initiatives would actually start diverting funds from other government priorities such as health care and other programmes. Financial resources are not limitless, governments have to set spending priorities. In Symphony, there are still over half a billion people without access to electricity.

The publication of this report and the roll-out of Scenarios at the Daegu Congress should not be the end, it should be the beginning. The Scenarios are not forecasts; they are credible explorations of two futures. In one, we pass through the so-called Doha Gateway (the agreements reached at the 2012 climate meeting in Qatar), and global governments all make the concessions necessary for global CO₂ governance. In the other, we leave it to market forces to choose between consumption and sustainability in an increasingly global energy market. In the event we expect the future will lie somewhere between the two, depending on the choices we make.

Rather than telling policy makers and senior energy leaders what to do, in order to achieve a specific policy goal, WEC's World Energy Scenarios to 2050 will allow them to test the key assumptions that they decide to make to shape the energy of tomorrow. Investors can use this tool to assess where are likely to be the most dynamic areas and real game changers of tomorrow. These scenarios are therefore likely to change the way energy decision makers consider the choices they make by understanding the real impact of their actions in the long term.

The WEC Energy Trilemma Flagship Programme sets out a roadmap for actions to address the world energy Trilemma. Our next step should be demonstrating with our scenario tools how this action plan could make substantial progress on achieving all three Trilemma goals by 2050. Are we "In

the Mood" for big band Jazz music? Will governments and the energy sector work together so that we get the best of both worlds with the markets reflecting a citizens' consensus on social equity and energy sustainability, and governments doing what only governments can do to enable the goals? The alternative is "A Cacophony", the worst of both worlds – governments making economically suboptimal policy decisions without getting citizen buy-in, and markets focussing on short-term price signals and encouraging self-interest, thus increasing both energy poverty and atmospheric CO₂ levels. □

WEC's 10 key scenario signal messages at a glance

1	Energy system complexity will increase by 2050: Integrated system modelling will deserve more attention in the future
2	The energy mix in 2050 will mainly be fossil based
3	The global economy will be challenged to meet the 450ppm target without unacceptable carbon prices
4	Balancing the energy trilemma means making hard choices
5	Regional priorities differ: There is no 'one size fits all solution' to the energy conundrum
6	Energy efficiency is crucial in dealing with demand outstripping supply
7	CC(U)S technology, solar energy and energy storage are the key uncertainties moving forward up to 2050
8	A low carbon future is not only linked to renewables: CC(U)S is important and consumer behaviour needs changing
9	Energy policy should ensure that energy and carbon markets deliver
10	Functioning energy markets require investments and regional integration to deliver benefits to all consumers