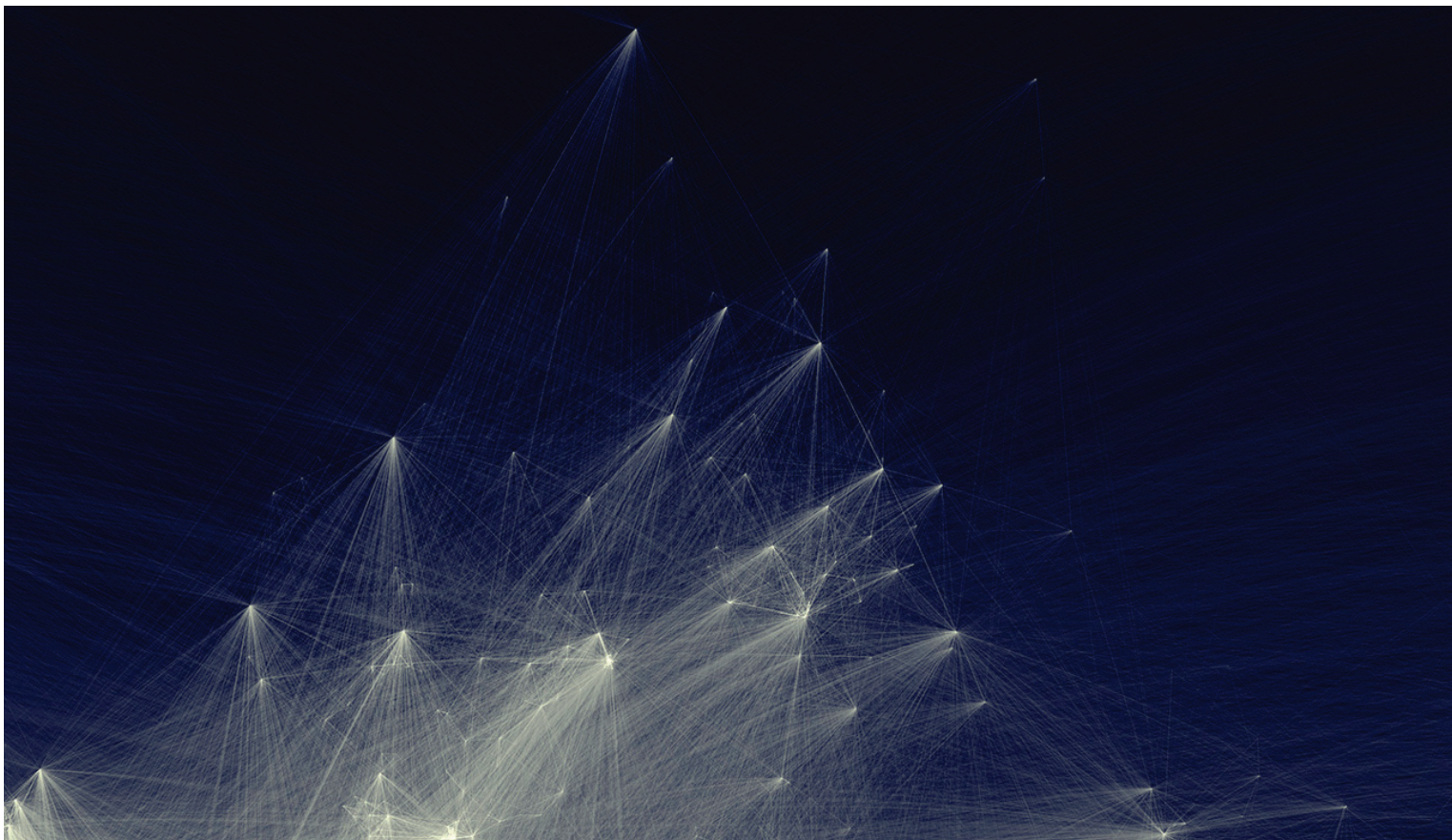


Norway and global leadership in the 21st Century

Supporting transformative low carbon ICT solutions



Dennis Pamlin

二十一世纪新前线
21st Century Frontiers
इक्कीसवीं सदी की सीमाएं



Study commissioned by EL & IT Forbundet

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<http://olihb.com/2011/01/23/map-of-scientific-collaboration-between-researchers/>

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List of Abbreviations

CCS: Carbon Capture and Storage

CDP: Carbon Disclosure Project

G8: Group of Eight

G20: Group of 20

GeSI: Global e-Sustainability Initiative

GHG protocol: The Greenhouse Gas Protocol

IT: Information Technology (in this report used as a synonym to ICT)

ICT: Information and Communication Technology

M2M: Machine-to-Machine

RFID: Radio frequency identification

Rio+20: United Nations Conference on Sustainable Development (UNCSD) 2012

UN: United Nations

UNFCCC: United Nations Framework Convention on Climate Change

Summary

The objective of with this report is to provide an overview of Norway as a low-carbon leader in the 21st century and present possible ways forward.

The methodology is a triangular approach that includes:

1. A quantitative assessment of how Norway and nine other Annex 1 countries integrate low-carbon ICT-solutions in their national communications to the UNFCCC.¹
2. Views among key stakeholders in Norway collected through interviews and provided material.
3. Views among key stakeholders outside Norway collected through interviews and provided material.

The report builds on the Guadalajara Declaration that was launched in Cancun during COP-16 and where a work stream to better integrate transformative ICT solutions in the global climate negotiations was initiated.²

Transformative ICT solutions are solutions that transform business models and allow countries to leapfrog past high emitting technologies. They often provide emission reductions of 80 per cent or more compared with status quo, and they depend on an underlying energy-efficient infrastructure.

Before the results are presented it is important to remember the context. The world is entering a time of rapid change and tipping points, a time when increased pressures due to converging trends will require, as well as trigger, transformative change. Few areas illustrate this more clearly than the need for reduced CO₂ emissions and a shift away from fossil fuel.

As long as the world was focused on incremental reductions of CO₂ emissions, i.e. around 5% as agreed under the Kyoto protocol, the focus was on the big emitters and how they could begin to reduce their emissions. The role of the ICT/IT sector was limited during this phase, and the focus on marginal improvement in high emitting sectors logical. It is now however widely recognized that whilst incremental solutions, those that marginally reduce emissions within current systems, are important they are far from sufficient.

This is especially true as CO₂ reductions must take place in a way that also takes into account, and delivers solutions to address, other converging trends such as an aging population, rapid urbanisation, unacceptable global income differences, growing unemployment, changing geopolitics and power balances, accelerated technological development. These converging trends requires solutions that delivers more than incremental changes within existing systems.

¹ Under the Climate Convention, all Parties should report on the steps they are taking to implement the Convention (Articles 4.1 and 12). Most of the 41 Annex I Parties submitted their first report (known as a "national communication") in 1994 or 1995, the fifth on 1 January 2010. Decision 9/CP.16 calls for submission of the sixth national communications on 1 January 2014.

http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/4903.php

²

<http://www.gesi.org/Media/GeSINewsFullStory/tabid/85/smId/503/ArticleID/71/reftab/37/Default.aspx>

By making use of exiting ICT solutions many of the main sources of CO₂ emissions can actually become part of the solution: instead of buildings that require a lot of electricity, smart buildings can be transformed into net producers of renewable energy, connected electric/hydrogen cars can become an integrated part of a zero emissions economy, and virtual meetings, e-health, e-education, dematerialisation of physical products and teleworking can all become part of a sustainable 21st century society.

Main conclusions regarding the “national communication” to the UNFCCC:³

Based on an analysis of how the words “ICT/IT”, “smart” and “innovation” were used in different countries’ “national communications” submitted in 2010 to the UNFCCC, the following observations can be made:

- Norway is lagging behind other IT leading countries when it comes to low-carbon ICT solutions as part of the national climate strategy.
- Norway only made two references to ICT/IT and none about ICT/IT as a solution provider.
- Norway did not mention “smart” solutions, i.e. how ICT/IT solutions can be utilized to address climate change.
- When it comes to innovation, Norway focused on the supply side (e.g. CCS and renewable energy) and not transformative changes.
- Countries, that increasingly focus on low-carbon development as a driver for business e.g. Japan, UK, Germany and Denmark, all acknowledge the role of ICT/IT and refer to innovation in the context of transformative solutions, not only in relation to supply-side measures.
- In sum, both a quantitative overview and a qualitative overview indicate that transformative solutions are almost non-existing in Norway’s communication to the UNFCCC. At the same time, much is happening in Norway and the potential is great for Norway to become a world leader in .?

Norway is already today a world leading country in many ways, with companies that provide and use transformative solutions as well as cities implementing new smart solutions to address climate change. However, there is substantial evidence that Norway faces significant challenges in terms of moving into an innovative and sustainable 21st century economy. A major challenge is that many of the previous strengths when it comes to delivering incremental reductions can make it more difficult for Norway to embrace the emerging challenges and turn them into opportunities. Norway seems to have strong structures that make it difficult to integrate transformative solutions into existing strategies and initiatives. Furthermore, leading “experts” on problems have limited understanding of the solutions needed in order to move beyond incremental reductions.

Main conclusions regarding Norway’s domestic situation:

³ Under the Climate Convention, all Parties should report on the steps they are taking to implement the Convention (Articles 4.1 and 12). Most of the 41 Annex I Parties submitted their first report (known as a “national communication”) in 1994 or 1995, and the fifth communication on 1 January 2010. Decision 9/CP.16 calls for submission of the sixth national communications on 1 January 2014.

In a situation with rapidly changing contexts it is important to acknowledge that the quantitative basis for this report, the national communications to the UNFCCC, might not be completely up to date. Further, as the submissions were done at different moments in time, spanning over more than twelve months, those handing in the submissions later could include more recent initiatives. Still the differences are very significant and Norway’s lack of ICT/IT as a solution provider in the national communication as well in the national climate strategy is striking.

- + World-class connectivity.
 - + IT interested population.
 - + Well functioning communication between ministries and sectors.
 - + World leading use and development of many low-carbon ICT solutions.
 - + Vision of a zero carbon and innovative future.
 - + “Leading” in many macro trends, such as ICT literacy, aging, understanding of the need to shift from a natural resource based economy to a service economy.
- Focus almost exclusively on the supply-side when it comes to low-carbon solutions, with additional focus on incremental improvements within existing systems. Very little focus on transformative solutions that can be used by 9 billion people, i.e. the future we are heading towards.
 - While there is a broad agreement on the need to move towards a zero carbon future with transformative solutions, few concrete work plans exist to implement such solutions.
 - While communication is well functioning and friendly between ministries actual collaboration around transformative projects is often lacking, making transformative solutions that require cross sectorial/ministry collaboration difficult to implement. Instead much of the focus is on incremental improvements within current areas of responsibility.
 - The policies and targets for climate change and CO2 reductions still focus on addressing problems, not creating solutions.
 - There is lack of clarity in terms of where the responsibility lies for low-carbon ICT support or transformative solutions as this is spread over a number of ministries. Ministries responsible for different ICT aspects have an understanding of the potential, but the Ministry of Environment has not moved beyond “sector by sector” and problem oriented approaches, and current goals are focusing on incremental CO2 reductions.

Much of the above could change fast, for example in the fall of 2011 when a new climate policy for Norway might be presented, but today there is a rapidly growing tension in Norway between “the first-generation of environmentalism” and what could be described as an emerging “second-generation of environmentalism”.

The first-generation identified problems, especially polluting companies, and tried to address the problem through incremental improvements within existing systems and through end-of-pipe solutions using a national perspective. The second-generation focuses on transformative solutions, especially solution clusters, with new and innovative ways of providing services. The perspective of the second-generation of environmentalism is global and the definition of sustainable is that the service can be provided in a sustainable way for nine billion people. The second-generation thus represents a shift away from incremental solutions within existing unsustainable systems.⁴

The first generation is institutionalized through the bodies responsible for “environmental issues”. While many working with the first-generation of

⁴ Instead of a better car, the focus is on smart working, resulting in promotion of teleworking. Instead of better airplanes the focus is on smart meetings, resulting in promotion of videoconferencing. Instead of better paper production the focus is on smart reading, resulting in e-books. Instead of CCS the focus is on smart buildings that provide lighting, a comfortable temperature, etc while being net producers of renewable energy at the same time.

environmentalism intellectually understand the need for a shift towards a new approach and frequently arrange seminars, produce reports, etc about the second-generation of environmentalism, the focus (including targets and capacity) is almost exclusively on incremental CO2 reductions within existing sectors with a national focus.

Norway can be described as a world leader in the first-generation of environmentalism. This leadership seems to have resulted in a situation where those in charge of “environmental” issues are intellectually grasping the need for a new approach, but the structures, traditions, mandate, etc push them back to a first-generation approach.

Norway has great potential to become a world leader in the second-generation of environmentalism, building on many interesting initiatives. The challenges should however not be underestimated and Norway needs to think in terms of leapfrogging and making significant changes in the current organizational structures in order to be able to play a relevant international role in the second-generation of environmentalism.

Possible ways forward

Organisational

- **Introduce a sector/service matrix to guide the next generation of low-carbon solutions and innovation support.**
 - Review current climate policies, based on incremental reductions within existing sectors, in relation to the need for 80-90% reductions and innovative ways to provide the services society needs.
 - Identify leaders in Norway that already have begun to deliver and use transformative solutions and then develop mechanisms to acknowledge as well as support these leaders.
- **Establish a “Global Net Positive Norway” Climate taskforce**
 - Establish a baseline for Norway’s global net climate impact (i.e. the result when emission reductions due to export from Norway of low-carbon solutions, are subtracted from the emissions due to export from Norway of high-carbon goods and services, such as oil)
 - Create an ad hoc working group, with members from all relevant ministries, for transformative solutions with the objective to develop a strategy and implementation plan for Norway as a “net-positive country”. A reference group with national as well as international stakeholders should also be established to ensure broad collaboration and access to best practice.
 - Identify solutions with multifunctional benefits (employment, equity, other environmental benefits such a reduced water use, etc). Ensure that all relevant stakeholders have the possibility to provide input in order to ensure that solutions are implemented that are demand driven.⁵
 - Use current activities related to the direct emissions, the embedded emissions and the impact from the oil cluster, especially re-investments and the oil fund, to see how Norway could help to reduce >600 million tonnes CO2 around the world.

⁵ Privacy and ownership issues are important to discuss and experts studies in these areas should be included in the work, e.g. <http://www.faf.no/pub/rapp/20166/20166.pdf>

Eight possible initiatives for Norway

1. **Norway 350³: Aiming for the moon**

As a contribution to a “Global Net Positive Norway” a project could be initiated that start by looking at the opportunities. Over the next 30 years more than 350 trillion dollars will be invested to provide people in cities with basic services such a lighting, communication, a comfortable temperature, etc. Norway could make a 350 trillion dollar opportunity assessment for global low-carbon (ICT) solutions and see how much of this money that could be invested in low-carbon solutions exported from Norway. Such an assessment could be linked to a report identifying transformative solutions from Norway that can help reduce global emissions with at least 350 million tonnes (the equivalent of the emissions from the export of Norwegian oil) when they are exported. This would help the world towards a 350ppm scenario.

2. **Transformative collaboration platform**

Create an open collaboration platform for transformative solutions. A “collaboration and synergy index” could be developed to track how ministries as well as sectors are collaborating to develop and implement transformative solutions.

3. **“Aging for innovation”**

Initiate a global “Aging for innovation” initiative. The demographic changes that are taking place will require societies to fundamentally rethink how they are organised. In many countries the aging population is seen as a problem with collapsing pension funds, exploding health costs and involuntary unemployment. Norway could take the lead in a global “Aging for innovation” initiative where the demographic change is seen as a driver for innovation to address climate change and other major challenges.

4. **Sovereign wealth funds for transformative change**

Launch a global sovereign wealth funds initiative for transformative change. Norway could launch an initiative for investors, with a specific focus on sovereign wealth funds and how they can support transformative solutions. The fund could start by:

- Asking companies to report how much they have helped reduce emissions in society with their products and services (not only the Scope 1-3 emissions).
- Asking companies to provide information on what transformative (ICT) solutions they can provide which nine billion people eventually can make use of, (as opposed to solutions which are not sustainable as they are not applicable on a global scale without destroying the planet).

5. **Young entrepreneurs for global solutions**

A new generation sees ICT as an integrated part of life and has a deep understanding of the challenges society faces. Norway could help launch the first young entrepreneurs for global solutions initiative using Web 2.0 and mobile applications.⁶ For example a “Code of the year”, where a prize is given to the best low-carbon software, could be launched at Rio+20 in 2012.

⁶ For more information about web 2.0 and mobile applications for sustainable development please see: http://www.pamlin.net/other_documents/Saving_the_planet_with_Web-2point0-101112.pdf

6. Public procurement for transformative solutions

Review the rules for public procurement and explore the possibility to:

- Base procurement on service, not products. E.g. smart meetings should be requested, not low-carbon air flights (so that virtual meetings can be included).
- Ask for net positive ICT solutions so that providers of servers, mobile devices and software are required to provide information about the CO2 impact of their solutions.

7. Establish a low-carbon feedback mechanism

One of the main challenges with transformative low-carbon solutions is that they help save significant amounts of resources (time and money) on top of the CO2 savings. This is very good if these resources are re-invested in more low-carbon solutions. If however these resources are invested in high-carbon products/services, e.g. if people telework and use the money and time they save to invest in SUVs the overall impact will be negative. Similarly, if a government supports teleworking, the money saved from e.g. less road repairs should not be invested in fossil fuel extraction, but should rather be invested in smart solutions such as e-health.

8. 9 billion people global sustainability filter

A filter should be introduced that require stakeholders, including the government itself, to measure the global impacts of all major investments and initiatives. In addition to measuring domestic CO2 reductions, the possibility to provide 9 billion people with basic services should also be used as an indicator.

1. Introduction

The world is entering a time of rapid change and tipping points, a time when increased pressures due to converging trends will require, as well as trigger, transformative change. Few areas illustrate this as clearly as the need for reduced CO₂ emissions and a shift away from fossil fuel.

As long as the world was focused on incremental reductions of CO₂ emissions, i.e. around 5% as agreed under the Kyoto protocol, the focus was on the big emitters and how they could begin to reduce their emissions. The role of the ICT/IT sector was limited during this phase, and the focus on marginal improvement in high emitting sectors logical. It is now however widely recognized that whilst incremental solutions, those that marginally reduce emissions within current systems, are important they are far from sufficient.

Conservative estimates based on old models, such as those in the SMART 2020 report, have demonstrated that there is potential to reduce global emissions with ICT solutions by more than 7.8 Gt by 2020, equivalent to a 15 per cent reduction of global emissions.⁷ With an increased focus on transformative solutions and use of modern models the contributions from smart ICT solutions to emissions reductions would be significantly larger in both developed and developing countries, and could help to avoid a high-carbon lock-in.

Transformative ICT solutions are solutions that transform business models and allow countries to leapfrog past high emitting technologies. They often provide emissions reductions of 80 per cent or more compared with status quo, and they depend on an underlying energy-efficient infrastructure.

The estimated share of the global CO₂ emissions from the ICT-sector will increase from current 2 % to 4 % by 2020 so it is important that companies and policy makers support the potential for ICT to become part of the solutions by ensuring that the use of ICT help reduce emissions in society.⁸ While reductions of ICT's own emissions (2%) are important, it is how ICT is used to help reduce the main bulk of the emissions in society (98%) that will determine if ICT is part of the solution or not..

Transformative solutions, for reduced emissions, in particular require policy support as they challenge current rules and regulations, as well as responsibilities within current systems. ICT is best described as a catalyst and depending on the surrounding systems and values, it will deliver very different results.

By making use of exiting ICT solutions many of the main sources of CO₂ emissions can actually become part of the solution: instead of buildings that require a lot of electricity, smart buildings can be transformed into net producers of renewable energy, connected electric/hydrogen cars can become an integrated part of a zero emissions economy, and virtual meetings, e-health, e-education, dematerialisation of physical products and teleworking can all become part of a sustainable 21st century society.⁹

⁷ <http://www.gesi.org/ReportsPublications/Smart2020/tabid/192/Default.aspx>

⁸ <http://www.gesi.org/LinkClick.aspx?fileticket=tbp5WRTHUoY%3d&tabid=60>

⁹ ICC Discussion Paper: ICTs and Environmental Sustainability, Document No 373/494, Oct 2010

Future service delivery in health, education, energy, transportation and content distribution will rely on ICT solutions. This will also increase the importance of ensuring that countries plan for a 21st century broadband infrastructure that enables access to these solutions.

By 2020 there could be 50 billion connected devices, and the number of mobile subscriptions is expected to reach six billion.¹⁰ Machine-to-machine (M2M) connectivity will allow for solutions that deliver real time information, dematerialisation and support for low-carbon lifestyles. With the right type of policy and investment frameworks, the uptake of these solutions can be accelerated, and the resources saved can be used to accelerate further carbon reductions.

The UNFCCC processes and global climate negotiations could benefit from focussing on transformative solutions, and should begin to include solution providers like the ICT sector in the development of current and future policies. Still only a few leading countries are active in promoting transformative solutions and publicly recognising ICT.

¹⁰ <http://www.ericsson.com/thecompany/press/releases/2010/04/1403231>

2. Objective and methodology to understand a country's low-carbon ICT leadership

The objective with this report is to provide an overview of Norway as a low-carbon leader in the 21st century and present possible ways forward.

The methodology is a triangular approach that includes

1. A quantitative assessment of how low-carbon ICT-solutions are integrated in the national communications to the UNFCCC by ten Annex 1 countries.¹¹
2. Views among key stakeholders in Norway collected through interviews and provided material.¹²
3. Views among key stakeholders outside Norway collected through interviews.

The methodology builds on the Guadalajara Declaration that was launched in Cancun during COP-16, where the need for transformative solutions was recognised and a work stream to better integrate transformative ICT solutions into the global climate negotiations was initiated.¹³ The methodology also builds on the Low-Carbon Leaders project under the UN Global Compact which promotes transformative solutions and where recommendations for accelerated uptake of such solutions have been developed.¹⁴

The information collected from stakeholders builds on a framework under development for the Global e-Sustainability Initiative (GeSI) to assess low-carbon ICT leadership and best practice among governments.

The quantitative assessment focused on to what extent ICT as a solution provider is integrated into the respective national climate strategies.

The quantified assessment of the national communications is meant to provide a rough idea of Norway's current position in relation to nine other leading countries in a similar situation to Norway when it comes to the use of ICT to help reduce CO₂

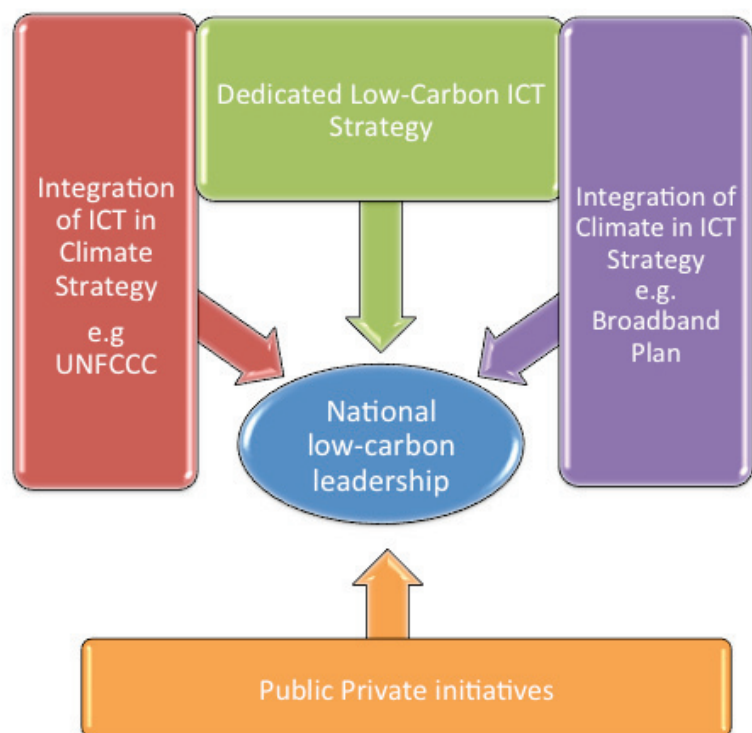


Figure 1: Estimating governments low-carbon leadership

¹¹ http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/4903.php

¹² Interviewed stakeholders are listed in Annex 1.

¹³

<http://www.gesi.org/Media/GeSINewsFullStory/tabid/85/smId/503/ArticleID/71/reftab/37/Default.aspx>

¹⁴ <http://www.transformative-solutions.net/>

emissions.

The countries were selected using the World Economic Forum “Network readiness index”.¹⁵ The top-countries from this index, that also belong to the Annex 1 group and have taken the international climate negotiations seriously, were selected.

Using the national communications to the UNFCCC as an indicator to assess how well ICT is integrated in the climate strategy of a country assumes that the UNFCCC process is taken seriously and that countries report on-going initiatives at the national level to the UNFCCC. However, the Ministry of Environment, that in most countries is in charge of the UNFCCC negotiations, might not be informed or aware of the low-carbon ICT work undertaken by other ministries, or might not perceive it as relevant, or might chose to ignore such work for other reasons. It is therefore not an assessment of the actual leadership when it comes to implementation of solutions, but an indicator of how well ICT solutions are integrated in a country’s climate policy.

For a more comprehensive understanding of a country’s low-carbon ICT leadership it would be necessary to both assess how well a country has integrated climate concerns in the ICT strategy, for example if climate solutions have been integrated in the national Broadband plan, as well as to assess separate/dedicated plans for low-carbon ICT. A country might for example have a dedicated low-carbon ICT strategy (as demonstrated by the leading countries in this report). Such a strategy can cover some or more of other key areas such as buildings, transport/communication, and consumption patterns. This report only assess the integration of ICT/IT into the national communication to UNFCCC.

A country can also have a lot of low-carbon ICT activity without any, or only minor, national governmental support. In many countries the ICT sector took the lead in different public-private initiatives, before the national government acknowledged the important role of ICT to enable a low-carbon society.

The interviews with stakeholders in Norway were meant to capture the activities of the Norwegian government beyond the national communication to the UNFCCC, as well as to provide input to possible ways forward.¹⁶

¹⁵ See Appendix 2:

<https://members.weforum.org/pdf/GITR10/TheNetworkedReadinessIndexRankings.pdf>

¹⁶ See Appendix 1 for the people interviewed.

3. Low carbon ICT solutions in Norway: as seen from abroad - The case of National communications to the UNFCCC

Four different aspects were assessed using the fifth national communications to the UNFCCC from ten leading Annex I Parties.¹⁷

- First, the prevalence of the words ICT and IT was assessed as a way to get a rough idea if the subject is included in the communications at all.
- Second, an assessment was made to see if the countries approach ICT/IT as a source of emissions (2%), or as a low-carbon solution provider (98%) or as an administrative tool (to keep track of emission inventories, etc).¹⁸
- Third, the use of the word “smart” was calculated in order to see if countries refer to low-carbon ICT/IT solutions, but without using the words ICT or IT.
- Fourth, the use of the word “innovation” was calculated in order to see if countries focus on new ways to solve climate change. A qualitative assessment was also done to understand the context where the word innovation was used.

3.1 Inclusion of ICT/IT in the National communications

Norway only mentions ICT/IT two times in the National communication. Still this is twice as much as the neighbour Sweden with only one mentioning. The difference between Norway on one hand and Denmark, Germany and Japan on the other is however striking. These countries mention ICT/IT between 12 and 24 times. Even if the approach to just calculate the number of times the words are mentioned is very simple, it seems to provide a reasonable filter to identify leading countries. Denmark, Germany and Japan all have low-carbon ICT strategies and, with the possible exception of UK and France that use different terminology, a frequent mentioning reflects comprehensive work with low-carbon ICT solutions.

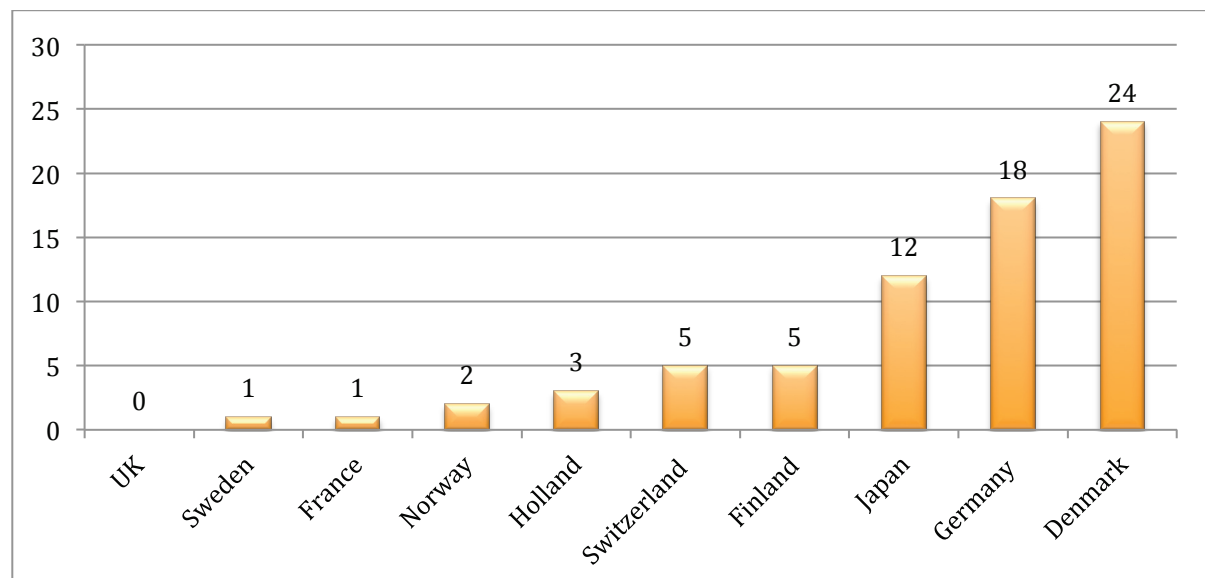


Figure 2: Number of times “ICT” or “IT” is mentioned in the national communications

¹⁷ The text from France that was analysed was the 19-page summary in English, not the full 203 pages in French so the quantitative measures for France cannot be compared directly with the other countries for which the full submissions were analysed.

¹⁸ http://assets.panda.org/downloads/wwf_greening_with_it_web.pdf

3.2 Approach to ICT/IT in National communications¹⁹

Norway does not mention ICT/IT as a solution provider at all. When ICT/IT is mentioned it is as an administrative tool and as a source of emissions: ICT is mentioned once as a source of emissions and IT once as an administrative tool.

ICT/IT as a source of emissions (page 102)

“An environmental policy for central government procurement has been specified and entered into force 1 January 2008 and shall be integrated into the environmental management systems and procurement routines of all national government institutions. The policy sets specific requirements for procurement of 15 priority products groups such as property management building, transport and vehicles, **ICT equipment**, textiles, health and hygiene consumer material, printed matter and paper, office furniture and supplies, cleaning and hotels. Indicative product criteria and capacity-building assistance has been made available for public procurement officers.” [Mentioning of ICT highlighted with bold by the author.]

ICT/IT as an administrative tool (page 32)

“Measures to safeguard, maintain and recover data
Access to the room where registry hardware is stored is restricted to **IT personnel** only. The registry servers are located on virtual servers, i.e. our VMware ESX Enterprise server farm. This ensures availability in case of server hardware failures. Registry servers will automatically be moved to a healthy member of the ESX farm if hardware faults are imminent. Full database backup is taken two times daily with transaction logs on a daily four hour schedule. Full file backup is taken on each Friday and incremental file backup once every day between.” [Mentioning of IT highlighted with bold by the author.]

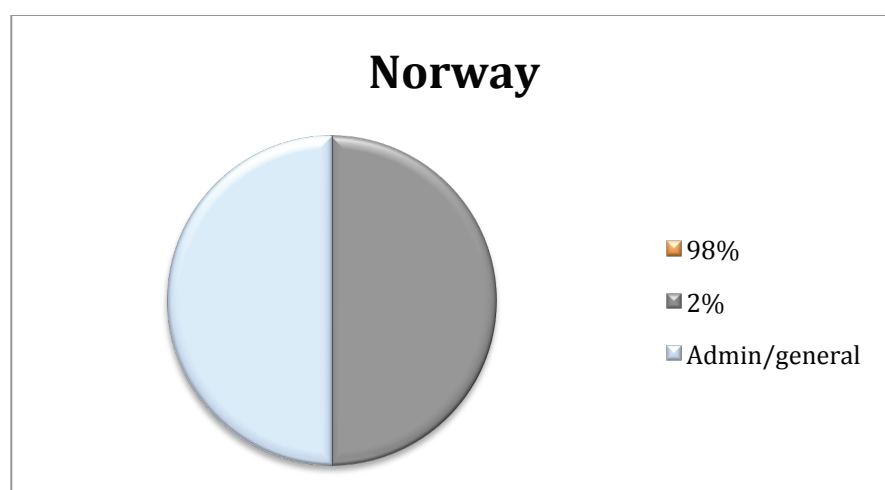


Figure 3: Norway's approach to ICT/IT

¹⁹ As UK is not mentioning ICT or IT in their communication they are not included in this assessment.

Two countries, Sweden and France, only mention ICT/IT in relation to its use as an administrative tool (to keep track of emission inventories, etc).

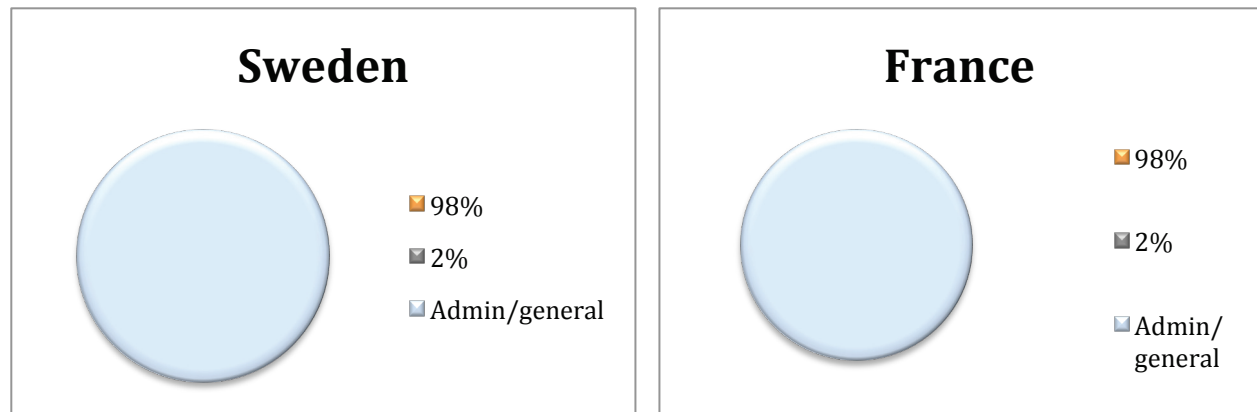


Figure 4: Sweden's and France's approach to ICT/IT

Most similar to Norway is Switzerland that also focuses on ICT/IT as an administrative tool and mentions ICT/IT as a source of emissions that must be dealt with.

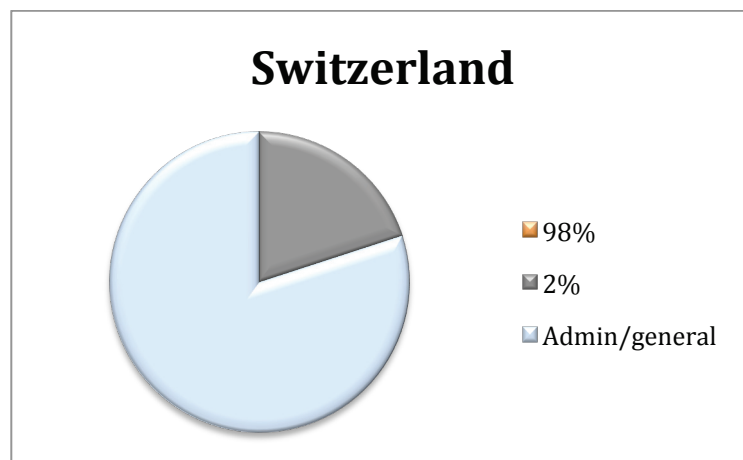


Figure 5: Switzerland's approach to ICT/IT

Among the Nordic countries it is Denmark that is the leading country today when it comes to low-carbon ICT solutions in the National Communication. While the low-carbon solutions from ICT/IT are still mentioned fewer times than ICT as a source of emissions, is clearly integrated into a solution agenda. Denmark also makes a clear distinction between ICT/IT as a solution provider and ICT/IT as a source of emissions, and has included a summary of their low-carbon/Green-IT strategy.

"The Action Plan for Green IT from the Ministry of Science, Technology and Innovation pursued two main objectives:

1. Citizens, businesses and public authorities' use of IT should be greener. The public must grow better at using IT in an environmentally friendly way, and it should be made easier for the public to choose energy-efficient IT products. Corporate IT use must become greener and Green IT must be incorporated into corporate social responsibility, along with other environmental issues. Finally, the

public authorities need to grow better at saving power and choosing energy-efficient IT solutions.

2. IT should help bring about a reduction in overall energy consumption. Smart IT solutions can, in many instances, help to reduce energy consumption and thus CO₂ emissions. For example, intelligent management of electrical devices in businesses and in private homes can ensure that energy consuming equipment is not switched on when not in use. Furthermore, the use of electronic mail and eGovernment by public authorities can save both paper and transportation.

Therefore, new research must be initiated to refine existing IT-based solutions and to develop completely new IT-based solutions for a sustainable future.”²⁰

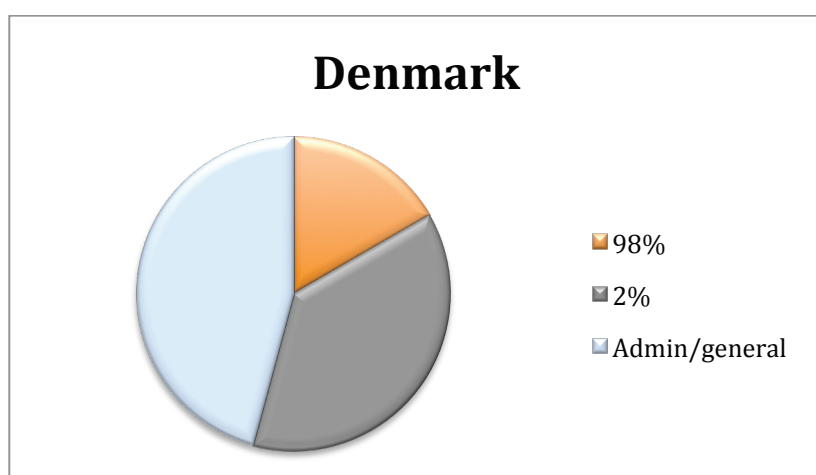


Figure 6: Denmark's approach to ICT/IT

Finland is similar to Denmark, but does not approach ICT as a solution provider in a structured way. The part that is included is however quite innovative as it addresses new innovative ways of using ICT to encourage sustainable consumption patterns.

Climate Bonus: Combining carbon footprinting, monitoring, feedback and rewards, and demonstrating the potential of green ICT

The implementation of ambitious climate policies needs new instruments and approaches that go beyond the current portfolio of policies and measures. In the Climate Bonus project (2008–2009), a feedback and reward system for households and retailers was developed by a consortium of five Finnish research institutions and six companies. The piloted ICT service enables consumers to monitor and follow the accumulated greenhouse gas emissions of their household purchases. Users of the service also have the possibility to compare their results with target levels and other users of the system. They can acquire bonus points (credits), e.g. on the basis of a reduction of the greenhouse gas intensity.²¹

²⁰ Page 447-448, "Denmark's Fifth National Communication on Climate Change"

²¹ Page 225 Finland's Fifth National Communication on Climate Change

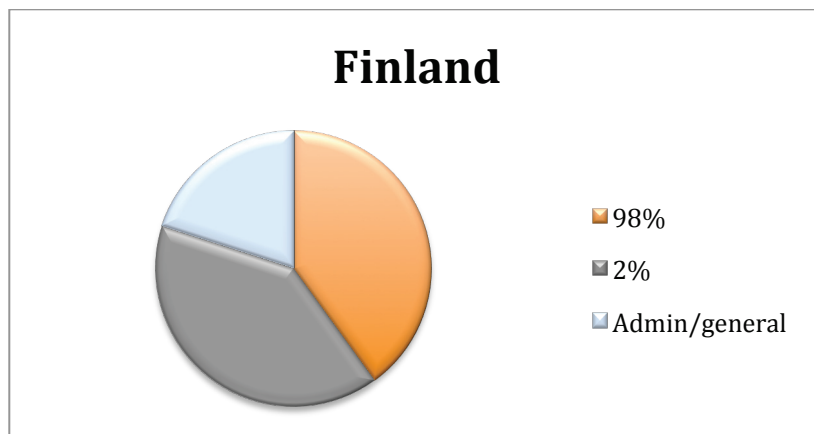


Figure 7: Finland's approach to ICT/IT

Holland also includes ICT/IT as a solution provider, but similar to Finland no clear distinction is made between ICT/IT as a source of emissions and as a low-carbon solution provider.

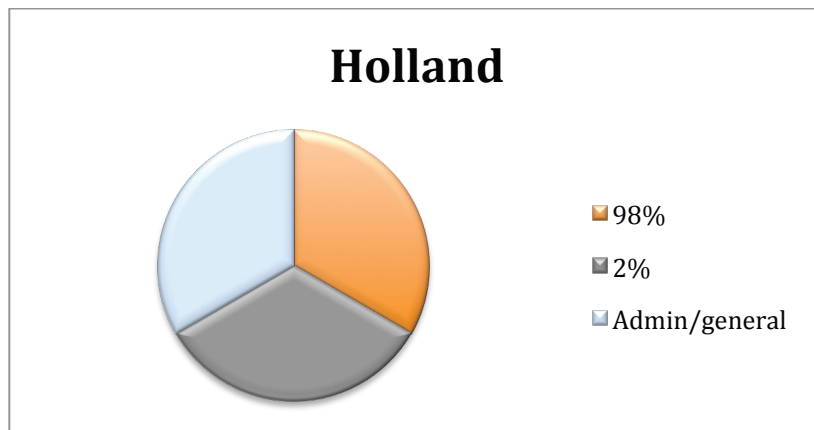


Figure 8: Holland's approach to ICT/IT

Germany refers more frequently to ICT/IT as a solution than a problem. Still, the approach is quite unstructured and the only strategy that is referred to is a general strategy for ICT/IT which hardly mentions low-carbon ICT/IT.²² Most of the focus in this strategy seems to be on incremental improvement within existing systems, but it does acknowledge ICT/IT as a solution provider.

"Environment-friendliness means energy efficiency and reduced pollution. Energy efficiency can be increased by comprehensive energy management. Electronic systems also play a major role in controlling the drive train. The tasks for future electronic engine systems include increasing engine efficiency, reducing pollutant emissions and integrating electric drive systems (hybrid solutions). This requires extensive development of power electronics and mechatronic systems."²³

²² <http://www.research-in-germany.de/dachportal/en/downloads/download-files/9438/ict-2020-research-for-innovation-2007-80-pages-.pdf>

²³ ICT 2020, Research for Innovations, <http://www.research-in-germany.de/dachportal/en/downloads/download-files/9438/ict-2020-research-for-innovation-2007-80-pages-.pdf>

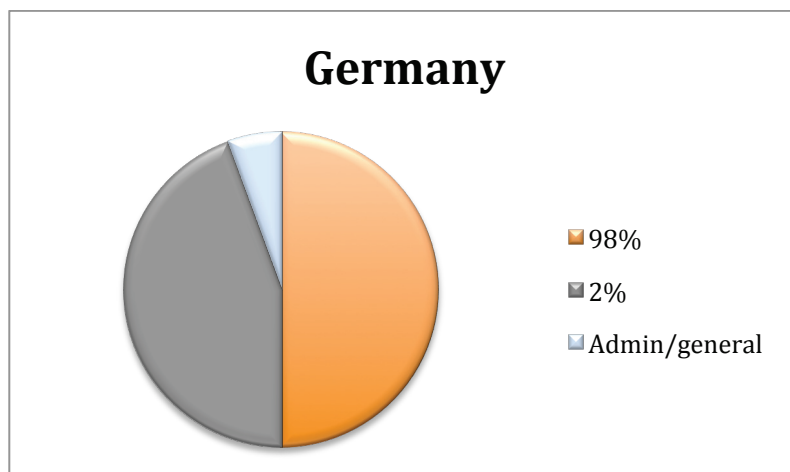


Figure 9: Germany's approach to ICT/IT

The country that is outstandingly the best in this group of countries is Japan. Japan makes a clear distinction between the 2% and the 98% (page 175 in the communication) Japan does not mention ICT/IT very many times, but when it is mentioned this is done in elaborated and structured ways that clearly indicate a deep understanding of ICT as a solution provider. Japan is also leading when it comes to setting specific goals and explaining strategies to deliver on those goals. This is not surprising as Japan has one of the world's most, perhaps the most, sophisticated approaches to ICT as a solution provider. This was demonstrated during the Japanese chairmanship of the G20 when ICT as a solution provider was promoted, both in terms of existing strategies as well as the Green IT council.²⁴ Still most of these initiatives date back to about 2007-2008, so there is a chance for other countries to catch up if they want to.

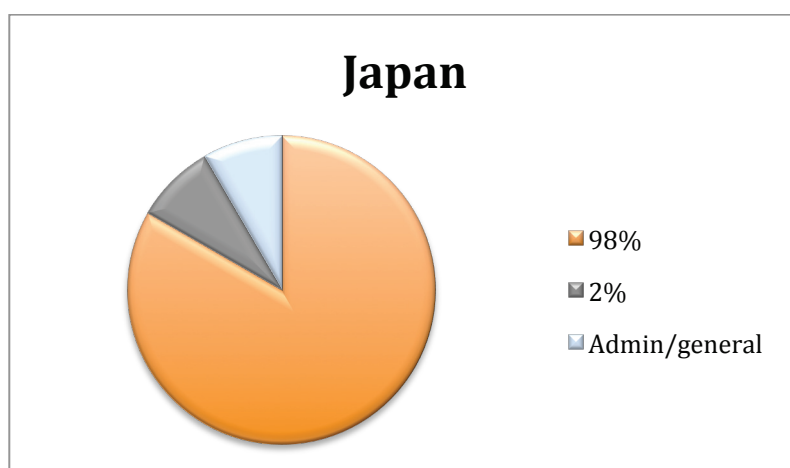


Figure 10: Japan's approach to ICT/IT

²⁴ <http://www.meti.go.jp/english/policy/GreenITInitiativeInJapan.pdf>
<http://www.greenit-pc.jp/e/about/>

3.3 Promoting “smart” development in the National communications

Within some governments and businesses ICT/IT solutions are not referred to as “ICT/IT-solutions” but instead “smart solutions” and therefore the use of the word “smart” was also included in the study.

Norway, together with Japan, Switzerland and France, do not include the word “smart” at all in their national communications. For Japan the reason is that this is not a concept that is used in this context. France’s communication was only a short English version and France seems to prefer the use of “innovative solutions”.

UK is worth noticing as they did not even mention ICT/IT (thus UK is not included in the analysis above) but they use “smart” to describe many ICT/IT related solutions such as smart transport, buildings and consumption as well as research. Sweden is similar to the UK but on a much lower level: four smart solutions are mentioned and whilst ICT could be included in these, this is not necessarily the case.

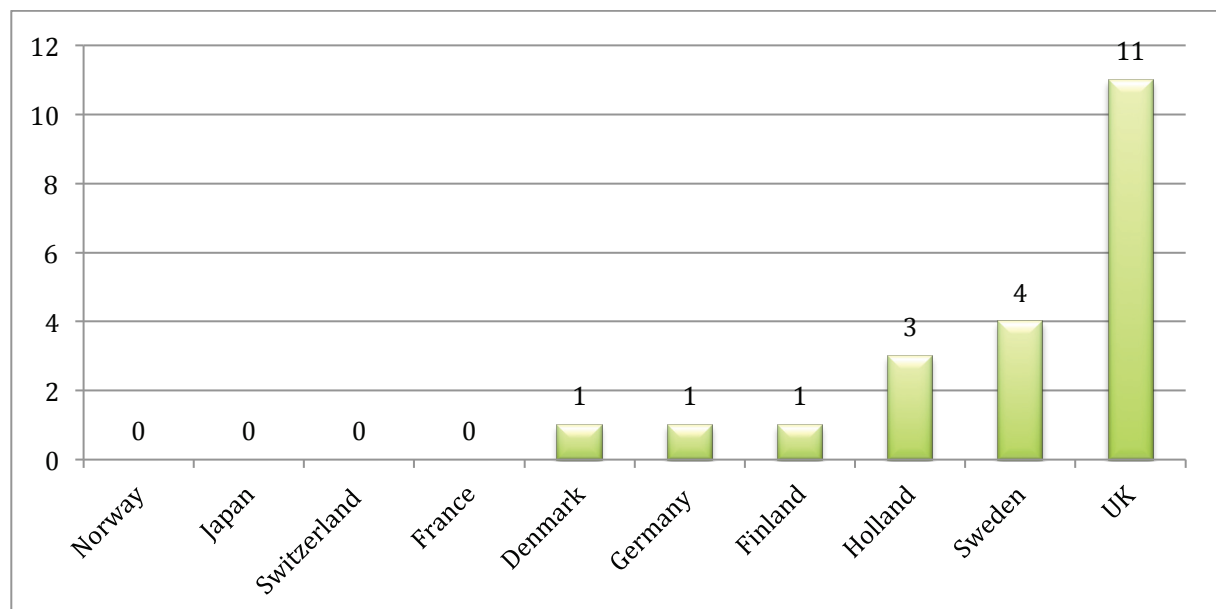


Figure 11: Number of times “Smart” is mentioned in the national communications

3.4 Promoting “innovation” development in the National communications

Norway is just on the lower half of how often countries use “innovation”, but what is more surprising is that Norway tends to use innovative almost exclusively in relation to supply side solutions such as CCS and wind power (page 34, 41 and 89). So not only is innovation referred to quite seldom, it is also not referred to from the perspective of transformative solutions.

Germany, Holland, and to some degree UK, mention innovation frequently in their National communications. In these cases transformative innovation is more common than in Norway.

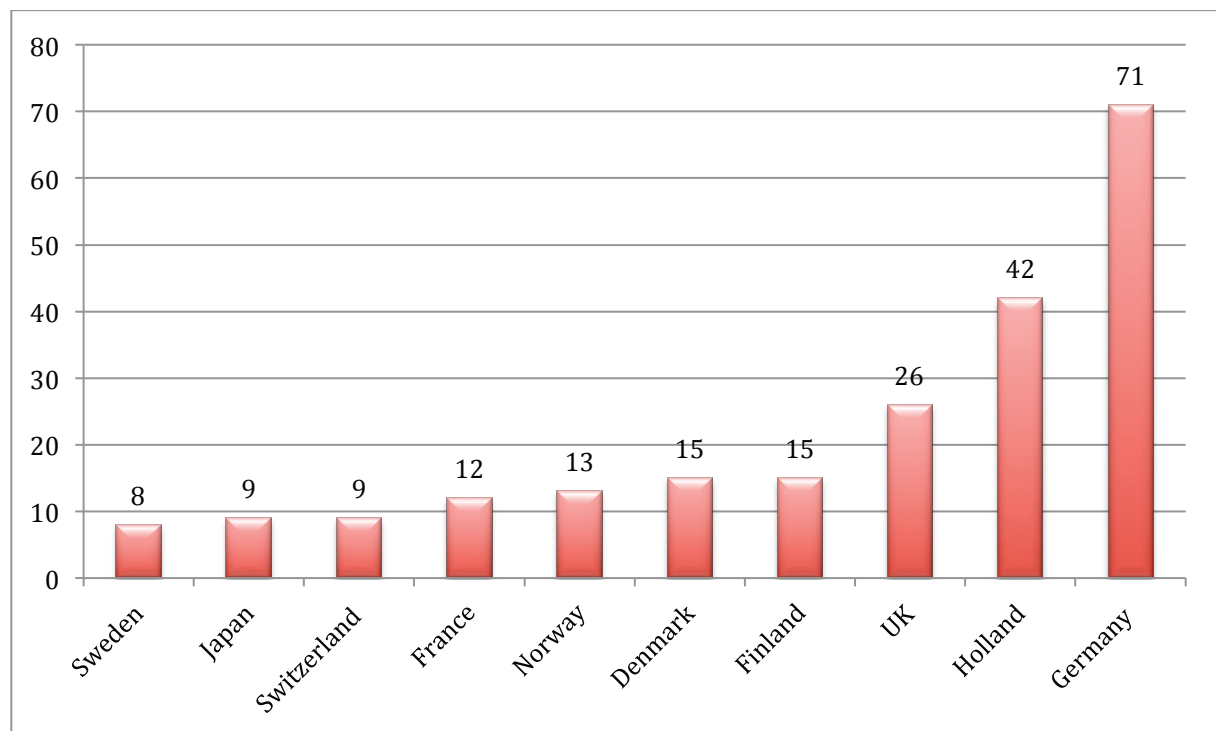


Figure 12: Number of times “Innovation” is mentioned in the national communications

3.5 Aggregation of the quantitative assessments

Counting the use of words like “ICT or IT”, “Smart” and “Innovation” is a very rough method of measuring the submissions. The average ranking of Japan in such a table demonstrates the weakness of the methodology as Japan probably is one of the best in terms of making use of ICT /IT as a solution provider, as shown when the use of “ICT/IT” was analysed further. Still for Norway it is interesting to note that the only country that makes even fewer references to these words is France and they only submitted a summary in English, 19 pages compared to the full version in French with 203 pages plus 60 pages of appendixes.

It is reasonable to conclude that Norway could improve, both in the short term by better including the positive examples in the communication, but maybe more importantly in the medium- long-term by reviewing the possibility to develop a more innovation based climate policy with low-carbon ICT solutions. The Norwegian climate policy currently under development will be one important indicator of how far an innovation perspective has been integrated.

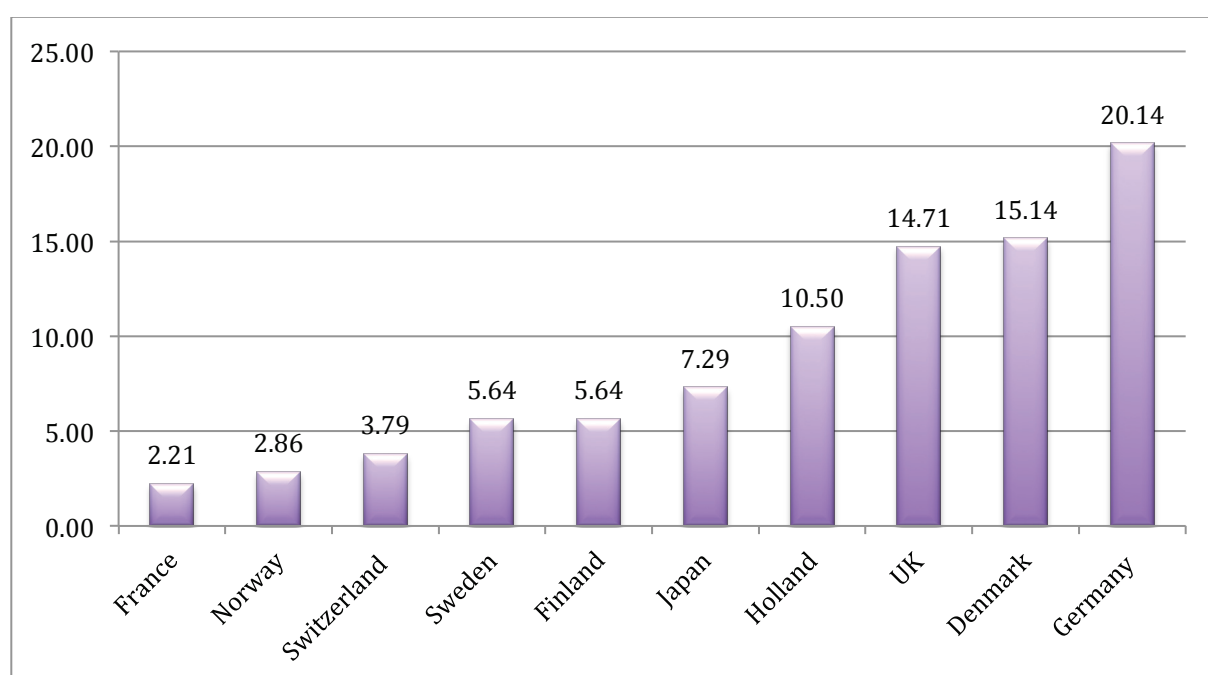


Figure 13: The aggregated (and weighted) number of times “ICT or IT”, “Smart” and “Innovation” is mentioned in the national communications

4. Low carbon ICT solutions in Norway: seen from within

“Global emissions will have to be reduced by 50-85 per cent by 2050, most likely closer to 85 per cent.”

Norway’s Fifth National Communication under the UNFCCC²⁵

The first thing to note with Norway is that almost regardless of the way in which countries are measured using current methodologies, Norway comes out as a leading country. Human Development Index, child mortality, life expectancy, ICT literacy, connectivity, pollution control, education, etc. all indicate a country that has few others to turn to for guidance when it comes to sustainable development.

Still, very few in Norway see the country as a leader. There are in particular two issues which keep reoccurring in discussions and documents: First, although Norway is a successful 20th century country, the

strengths that created the success and provided Norway with high material welfare have resulted in a structure that is not conducive to innovation. How this can change must be discussed.

Second, there is oil, that many think is an issue that must be discussed separately. Everything that Norway is doing in the area of oil, from more efficient production and CCS investment to discussions about the way sovereign wealth funds reinvest money and how oil-dependency can be reduced, have global impact. How these “oil strategies” relate to and could strengthen a transformative low-carbon strategy should be discussed.

Below the role of low-carbon ICT will be approached through these two filters and based on the assumption that low-carbon ICT solutions will be among the most important to ensure the CO₂ reductions needed by 2020 and 2050.

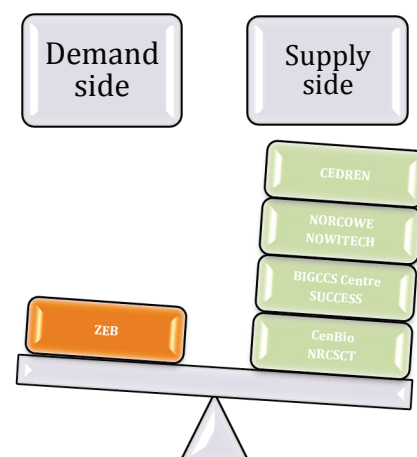


Figure 14: Graphic representation of Norway’s current low-carbon focus. It is based on the eight Centres for Environment-friendly Energy Research that was established in 2009. The 15th of February 2011 three new centres were presented. Hopefully these can help Norway to become more balanced.

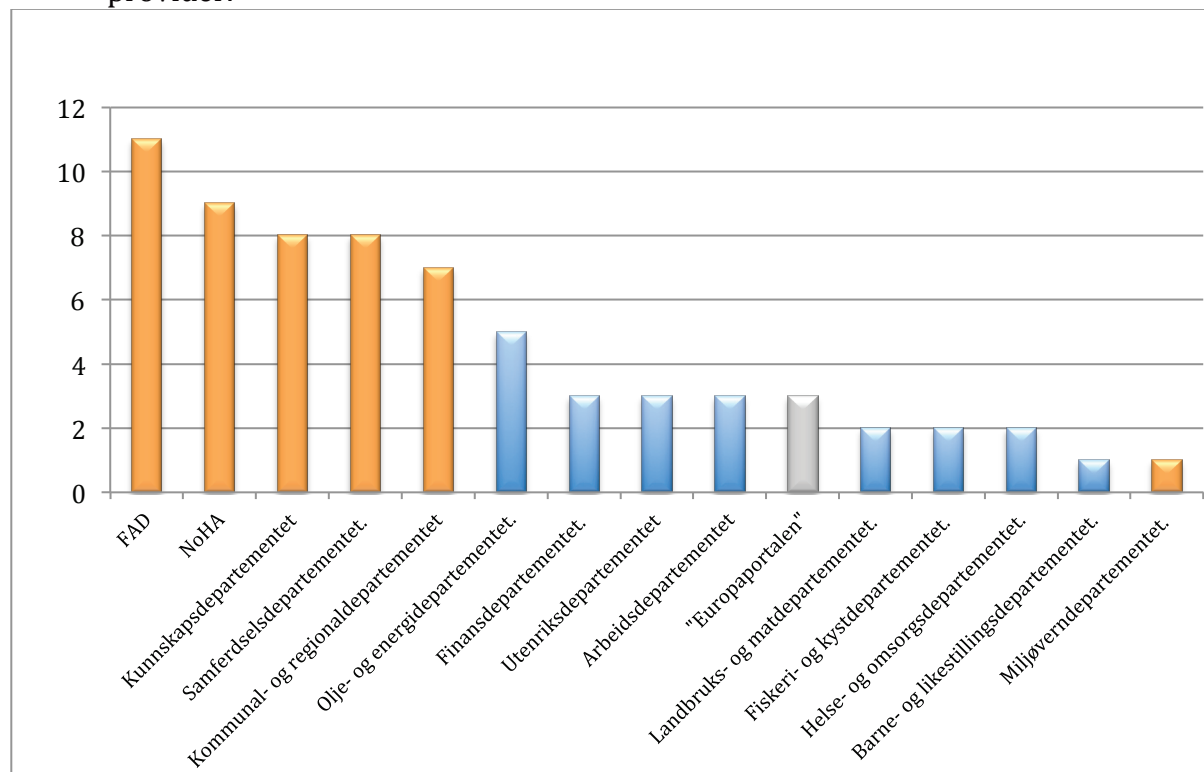
Demand side	Supply side
ZEB The Research Centre on Zero Emission Buildings	BIGCCS Centre International CCS Research Centre
	CEDREN Centre for Environmental Design of Renewable Energy
	CenBio Bioenergy Innovation Centre
	NORCOWE Norwegian Centre for Offshore Wind Energy
	NOWITECH Norwegian Research Centre for Offshore Wind Technology
	The Norwegian Research Centre for Solar Cell Technology
	SUCCESS Subsurface CO ₂ storage – Critical Elements and Superior Strategy

²⁵ http://unfccc.int/resource/docs/natc/nor_nc5.pdf

4.1 Collaboration, focus and division in Norway

The quantitative results from the “national communications” to the UNFCCC showed that Norway did not include ICT as part of the solution. To very briefly explore the domestic situation a search on the words “IKT”, “klima” and “smart” (Norwegian for “ICT”, “climate” and “smart”) was done on “Government.no –Information from the Government and ministries”. This search resulted in the graph below where the key players are indicated with orange colour.²⁶ Three things are particularly interesting to note:

- FAD (Fornyings-, administrasjons- og kirkedepartementet) is in the lead to integrate ICT and climate. The (previous) minister has also mentioned the roles of low-carbon ICT in speeches.²⁷
- A number of key ministries have begun to explore the possibilities for ICT to help reduce CO₂-emissions. Very promising is that these ministries are strong and relevant ministries. A next step could be to explore how well transformative low-carbon (ICT) solutions are integrated in “Innovasjon Norge” (under NoHA), “Norges forskningsråd” (under Kunnskapsdepartementet) and “Transnova” (under Samferdselsdepartementet).
- The Ministry of Environment is not strong when it comes to ICT as a low-carbon solution provider. The result indicates that the lack of integration of low carbon ICT in the national communication to the UNFCCC was not just a mistake but part of a systemic lack of integration of a solution perspective with ICT as a solution provider.



²⁶ <http://www.regjeringen.no/nb/sok.html?querystring=IKT+klima+smarte&id=86008>

²⁷ http://www.regjeringen.no/upload/FAD/Vedlegg/IKT-politikk/IKT_klimagassutslipp.pdf
http://www.regjeringen.no/nb/dep/fad/aktuelt/taler_og_artikler/av_ovrig_politisk_ledelse/politisk_raad_giver_leknes/2009/it-si-rolle-i-klimapolitikken.html?id=564830
http://www.regjeringen.no/nb/dep/fad/aktuelt/taler_og_artikler/minister/tidligere_fornyings_og_administrasjonsmi/2009/gronare-og-smartare.html?id=578683
http://www.regjeringen.no/nb/dep/fad/aktuelt/taler_og_artikler/av_ovrig_politisk_ledelse/politisk_raad_giver_leknes/2009/smart-gronn-vekst.html?id=574806

Figure 15 (on the earlier page): The number of times the words "IKT", "klima" and "smart" are all mentioned in a document on "Government.no".

A quantitative analysis of another key document confirms the lack of ICT/IT, smart and (transformative) innovation in Norway's current strategic discussions about a low carbon development. The document "Globale miljøutfordringer – norsk politikk" (Global environmental challenges – Norwegian political context) mentions the word "problem" 139 times, "mulighet" (possibility) 61 times, "olje" (oil) 21 times (plus three times related to the ministry with the word "olje" included) "Innovation" 2 times (twice in the text, but 32 times in titles of reports quoted), IKT, IT and smart are all mentioned zero times.²⁸

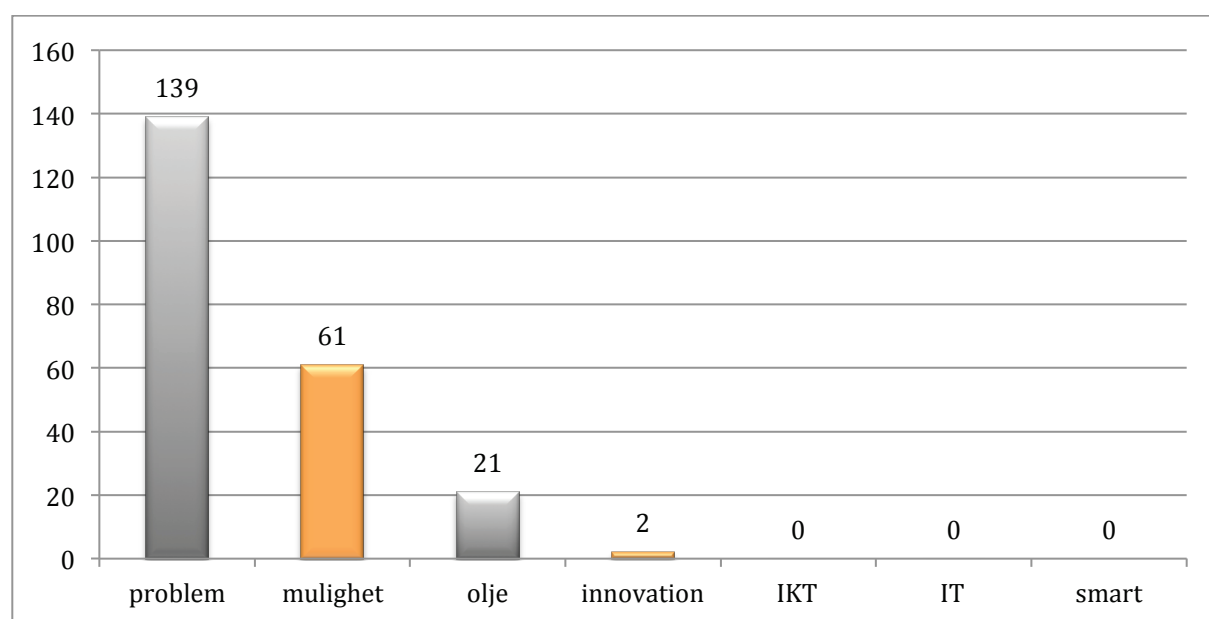


Figure 16: Number of times key words are mentioned in the main text of "Globale miljøutfordringer – norsk politikk"

4.2 Norway and global CO2 emissions: Ensuring focus where it makes a difference

"Home to a green-minded people and government, Norway exports the dirty stuff to the rest of the world. The result is a contradiction"

Headline in The Economist Jan 22nd 2009²⁹

Norway is a very interesting country as the climate perspective seems to be both very global and very national at the same time. Norway, as a small and well-educated country, understands the need to embrace a global perspective. With less than five million people it is obvious that any changes of emissions in Norway will have very small direct effect. At the same time, Norway's current economy revolves around oil and the way in which Norway will deal with investments in fossil fuel and how Norway will make use of the income from this oil (the Sovereign wealth fund) will have significant global impact.

Currently Norway's national low-carbon activities are seldom linked to the global impact in a strategic way (even if exceptions exists such as a group at the ministry of

²⁸ Thanks to Jan Kristensen, Telenor, for help identifying this. Telenor and Abelia provided the following feedback to the document: http://www.regjeringen.no/pages/2241640/Abelia_og_abelia2.pdf

²⁹ http://www.economist.com/node/12970769?story_id=12970769

industry exploring solutions that can be exported), and similarly Norway's activities on the global level, such as in the area of REDD, seem to have a weak link to the national strategies.³⁰

Even finding basic numbers of Norway's global climate impact as a result of the export of oil is very difficult. Contacts with multiple official stakeholders did not provide an answer, and a rough calculation was done for this report in dialogue with academic experts in Norway to establish the magnitude of Norway's impact.

Below are three estimations for absolute and per capita emissions in Norway. The numbers cover three different ways to measure Norway's impact.

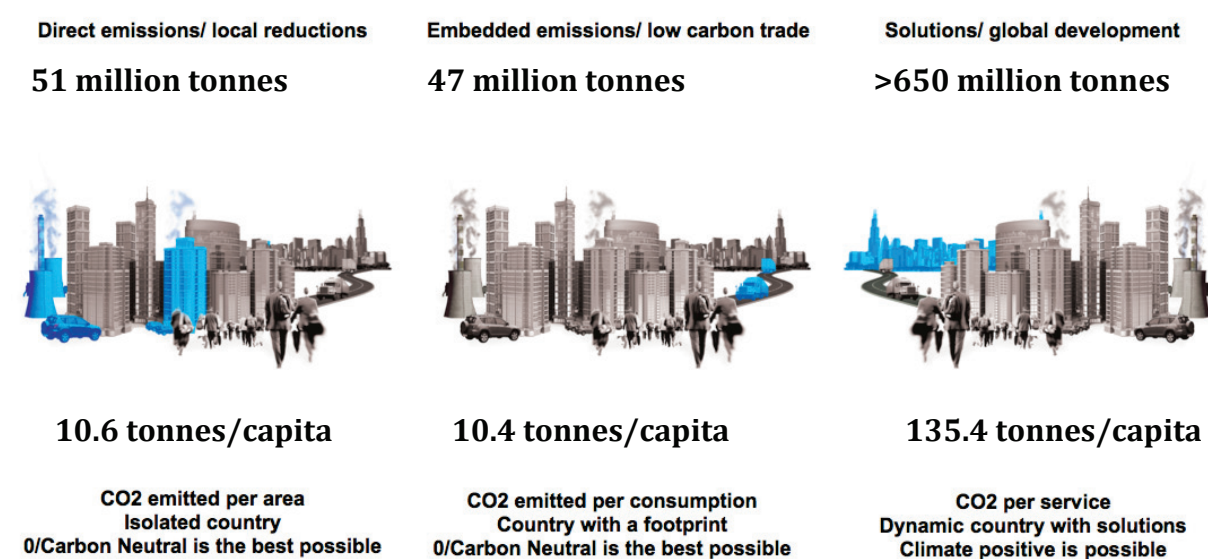


Figure 17: Three approaches to a country and emissions. Depending on focus very different strategies will be developed.³¹

> Direct emissions: 10.6 tonnes per capita

A "direct emission approach" is the traditional way of measuring a country's climate impact and the basis for the Kyoto protocol. This approach looks at the emissions within the geographical borders of a country.

Norway's total direct domestic CO2 emissions are approximately 51 million tonnes, or 10.6 tonnes per capita, calculated for 4.8 million people.³² The global average is about 4.5 tonnes. A sustainable per capital level is 1.5 and with a global equity and historic perspective the direct emissions in Norway should reach close to zero before 2050.

> Emissions including embedded emissions: 10.4 tonnes per capita (2001)

³⁰ http://www.norway.or.id/Norway_in_Indonesia/Environment/-FAQ-Norway-Indonesia-REDD-Partnership-/

³¹ The approach builds on work related to cities such as the Low Carbon City Development Index (<http://www.lowcarbondevelopmentindex.net/>) and a five step plan for low-carbon urban development developed by Ericsson (http://www.ericsson.com/res/thecompany/docs/corporate-responsibility/cr08_doc/wwf_ericsson_5step_plan.pdf).

³² http://www.regjeringen.no/nb/dep/oed/tema/olje_og_gass/Utslepp-til-luft-fra-petroleumsverksemda.html?id=481543

In contrast with the current approach of the Kyoto protocol – to look at emissions from a “nation”-perspective – the embedded perspective approaches emissions from a “consumption” perspective. The “direct emissions approach” under the Kyoto protocol, and many national climate strategies, made perfect sense when incremental reductions among the rich countries were discussed. However, when far more ambitious reductions are required, it is of crucial importance to also consider the kind of economy and life-styles that are promoted and thereby also focus on a country’s emissions generated by consumption.

While Norway’s CO₂ emissions remain fairly stable, Norway’s carbon footprint abroad is growing fast (33% 2001-2006, to 39 Mt) and is in the near future likely to surpass domestic emissions.³³

In 2001 – the most recent year for which data are available– the direct emissions were 54 Mt and the production of Norwegian imports generated 29 Mt CO₂ outside of Norway. The same year the production of Norwegian exports – generated largely by exports of oil and gas and international shipping – resulted in emissions of 36 Mt CO₂. Thus in 2001, Norway’s total carbon footprint was 47 Mt CO₂ (54+29-36) which is lower than the direct emissions due to Norway’s CO₂ intensive exports.³⁴ A more recent study, “Global carbon footprints Methods and import/export corrected results from the Nordic countries in global carbon footprint studies” by Glen Peters and Christian Solli, indicates that the imported CO₂ emissions overtook the exported from Norway around 2004.³⁵

> Emissions including consequences from fossil fuel export: 135.4 tonnes per capita

While the emissions related to lifestyle footprints/consumption, are important, the total CO₂ impact of a country must also include the consequences of the exports. Is the country exporting low-carbon solutions such as smart ICT solutions that help other countries to provide services needed in a sustainable way, or is the export based on goods/services that contribute to higher emissions?

In a small and successful country, like Norway, the solutions are mainly spread through best practice that others can copy or though the products and services that are exported.

Acknowledgement from the Norwegian government that it is necessary to include the consequences of export from Norway is not only important in order to understand the need for and potential of low-carbon ICT solutions. Acknowledgment is also important from a credibility perspective. Few countries are seen as having such a mixed approach to low-carbon development as Norway. On the one hand the country is considered to have progressive policy positions and rhetoric in place and has taken national as well as international initiatives that are world leading. On the other hand it is still lacking any credible oil policy and has not adopted a solution perspective, e.g. no calculations exist for measuring to what extent the export of solutions from Norway is helping to reduce emissions, no phase-out plan for oil exists, and maybe most surprising there is no low-carbon strategy for the sovereign wealth fund.

International stakeholders ranging from *The Economist* to James Hansen have

³³ http://assets.wwf.no/downloads/wwfrapport_jan2008_norsk_klimaavtrykk_i_kina_1.pdf

³⁴ http://assets.wwf.no/downloads/wwfrapport_jan2008_norsk_klimaavtrykk_i_kina_1.pdf

³⁵ Page 133: <http://www.norden.org/no/publikasjoner/publikasjoner/2010-592>

highlighted the tensions between the green and black climate policy in Norway. It is very likely that transformative low-carbon ICT solutions are caught in this tension and the current division between ministries in a way that can be solved if leading ministers agree to act. But only action on the highest level can turn the tension into something positive.

“When the government says Norway will be carbon neutral by 2030, it is taking only domestic emissions into account, not the much larger amount embedded in its hydrocarbon exports. By contrast, it does intend to count emissions cuts it has paid for overseas towards the goal of carbon neutrality. Those offsets will be paid for in part with revenue from oil and gas. In short, Norway is profiting handsomely at the planet’s expense, while spending a small share of the proceeds on projects to reverse a fraction of the damage done.”³⁶

The Economist, Jan 22nd 2009

“I hoped that Norway, because of its history of environmentalism, might be able to stand tall among nations, take real action to address climate change, drawing attention to the hypocrisy in the words and pseudo-actions of other nations.

So I wrote a letter to the Prime Minister suggesting that Norway, as majority owner of Statoil, should intervene in their plans to develop the tar sands of Canada. I received a polite response, by letter, from the Deputy Minister of Petroleum and Energy. The government position is that the tar sands investment is “a commercial decision”, that the government should not interfere, and that a “vast majority in the Norwegian parliament” agree that this constitutes “good corporate governance”. The Deputy Minister concluded his letter “I can however assure you that we will continue our offensive stance on climate change issues both at home and abroad”.

A Norwegian grandfather, upon reading the Deputy Minister's letter, quoted Saint Augustine: “Hypocrisy is the tribute that vice pays to virtue.”

The Norwegian government's position is a staggering reaffirmation of the global situation: even the greenest governments find it too inconvenient to address the implication of scientific facts.”

James Hansen, 2010³⁷

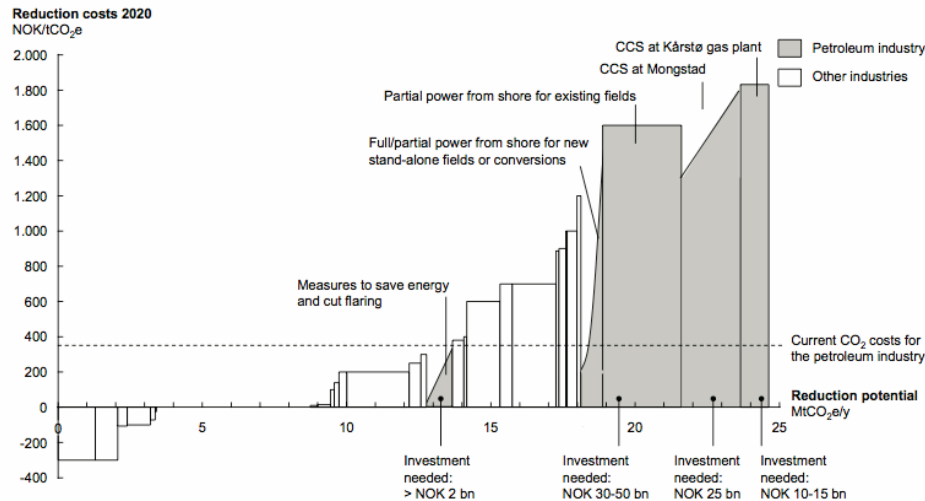
On a very concrete level this tension could result in a significant misallocation of resources: First, due to the linear approach, that is used as Norway focuses on incremental reductions sector by sector. Second, due to “the problem approach”, that is to say a focus on the emitters and how to reduce their emissions, as opposed to a solution oriented approach with a focus on supporting those that provide the services we need in a low-carbon society.

Figure 18 below shows what happens when the two approaches above are combined. First, a “McKinsey approach” is used with incremental improvements in existing sectors as the starting point. This approach excludes most transformative approaches and smart system solutions (from buildings that are net producers of electricity to innovative ways to provide services such as videoconferencing instead of flying). Second, investments by polluters are done in their “own sector” so that Norway runs the risk of expensive

³⁶ http://www.economist.com/node/12970769?story_id=12970769

³⁷ <http://www.columbia.edu/~jeh1/mailings/2010/20100824Activist.pdf>

investments that result in high-carbon lock-in instead of strategic investments in long-term sustainable solutions.



Cost curve for climate measures in Norway in 2020. See the main report (in Norwegian only) for details.

Figure 18: Cost curve for climate measures.³⁸

One report concludes that reduction efforts in the oil sector “avoided 40 million tonnes of carbon emissions in 1994-2007. The figure for 2006 alone was 4.5 million tonnes of carbon dioxide.”³⁹ Compared with Norway’s domestic emissions that is a lot, but a conservative estimation (not including any LCA emissions from the underlying infrastructure) based on the following formula from EPA in the US gives a very different picture:

“5.80 mmbtu/barrel * 20.33 kg C/mmbtu * 44 g CO₂/12 g C * 1 metric ton/1000 kg = 0.43 metric tons CO₂/barrel”⁴⁰ give the following result:
 2.2 million bbl/day = 0.95 million tonnes per day =
347 million tonnes per year or 72.3 tonnes per capita (only export and only oil)

These 347 million tonnes, that do not include natural gas, are equivalent to the direct emissions from more than seven Norway. If the impact of exporting gas and other petroleum products are added estimations indicate that Norway in 2005 contributed to more than 600 million tonnes of global CO₂ emissions, making Norway one of the ten

³⁸

<http://www.konkraft.no/postmann/dbase/bilder/KonKraft%20report%205%20The%20petroleum%20industry%20and%20climate%20issues%20-%20english%20summary.pdf>

³⁹

<http://www.konkraft.no/postmann/dbase/bilder/KonKraft%20report%205%20The%20petroleum%20industry%20and%20climate%20issues%20-%20english%20summary.pdf>

⁴⁰ <http://www.epa.gov/greenpower/pubs/calcmeth.htm>

most CO₂-emitting countries on the planet.⁴¹ It is highly likely that Norway is the most CO₂ polluting country in the world today when the consequences from export are included. In comparison, Saudi Arabia is exporting 3.4 times more oil than Norway, but has a population that is five times larger and UAE has a slightly higher population (not including all the guest workers that constitute about 70% of the population) and a slightly smaller export.

Norway's current contributions to the world can be compared with those of Denmark where wind power, now one of the leading export industries, and an export strategy to support low-carbon ICT solutions exists.

"Denmark is one of the leading countries when it comes to green technology – a status that obligates. Denmark ought to continue to take the lead and ensure innovation – also within the field of Green IT.

There are some countries in which IT-related development is proceeding quickly but where environmental consideration is not sufficiently integrated in IT use. Effort must therefore be made to export Danish Green IT know-how and technology.

Denmark will also be able to share know-how with other countries and gain from the experiences of other countries. Such expertise sharing will proceed via various international forums in which Denmark is represented, but also more targeted in specific countries, such as China and India.

The Ministry of Science, Technology and Innovation will launch an export and expertise campaign. The initial objective is a campaign in China, where there is a considerable potential market for Danish Green IT technology. In this connection, the Danish research and innovation centre in Shanghai will be included in the planning."⁴²

"With an aggregated export of 41.7 billion kr. (exceeding 5.6 billion euro) in 2009 the Danish wind industry maintained the high export figures from record breaking 2008 despite the financial crisis. The wind industry exports account for 8.5 per cent of total Danish exports in 2009 compared to 7.2 per cent in 2008."⁴³

The emissions from exported oil, and natural gas, can be seen as an inspiration as they present a challenge to Norway of a magnitude that will require both development of transformative solutions and innovative ways to distribute these solutions. In other words this challenge steers Norway towards a focus on the kind of solutions that the world actually needs. Rather than only focusing on reducing emissions from oil and gas (that is needed but this will happen anyway as the sector is under pressure), the main focus should be on exporting solutions that can help the world reduce as much emissions as Norway is contributing to due to the burning of the exported oil and gas.

⁴¹ Glen Peters sent calculations and have also written this article:
<http://www.cicero.uio.no/fulltext/index.aspx?id=6865&lang=NO>

⁴² http://www.itst.dk/filer/Publications/Action_plan_for_Green_IT_in_Denmark/html/chapter04.htm

⁴³ <http://www.energyportal.eu/latest-wind-energy-news/8745-danish-wind-industry-maintains-high-export-figures-in-2009-despite-financial-crisis.html>

Making 600 million (tonnes of CO₂) a well-known number in Norway will require courage from politicians in Norway, as it would require that Norway acknowledges the consequences from the oil and gas export. However, it would also allow Norway to have a clear ambitious target for the amount of reductions that solutions from Norway should contribute to. It would help shift the Norwegian climate discussions from a focus on problems and incremental reductions to a focus on opportunities and transformative solutions.

Two closely related areas have been mentioned by a number of stakeholders where such solutions could be developed and later exported, if the government, local authorities and business work together: smart cities and smart lifestyles.

- Smart cities have become one of the areas that many leading stakeholders are exploring. More than 350 trillion dollars will be invested to provide key services in cities around the world in the next 30 years. One of the most important features in a smart city is an underlying ICT infrastructure that allows information to move instead of physical goods, and where services can be provided in new innovative ways. Norway's initiative with "Framtidens byer" could become a key part of a transformative low-carbon (ICT) strategy. An overview of current implementation in leading cities such as Steinkjer⁴⁴, Malvik⁴⁵, Dyrøy⁴⁶, and Trondheim⁴⁷, could be a good starting point.
- Supporting sustainable lifestyles: A planet with nine billion people living a good life will require totally new solutions. The urgency of developing new solutions is increased by different pressures, ranging from depleting phosphorus supplies and rare earth metals, to the unsustainable use of the world's forests and (fossil) water.

The question for all strategic future city initiatives in Norway should be: What solutions in smart cities can be spread around the world and reduce at least 20 million tonnes of CO₂ emissions by 2020 and help add up to reductions that are larger than 600 million tonnes?

With an international reputation as an honest country and companies interested in helping to spread sustainable solutions, Norway could take the lead in the global solution oriented climate work. Companies like Telenor have a very strategic customer base that is expanding in many of the most dynamic markets. With three million subscribers in Norway solutions can be developed that later can be used by more than 100 million Telenor subscribers around the world.⁴⁸ By ensuring collaboration with other cities Norway could also help build a new generation of global innovation clusters.

⁴⁴ <http://www.sintef.no/Projectweb/Smartgrids/Smart-Grids--integrations/Demo-Steinkjer/>

⁴⁵ <http://www.malvik-everk.no/Documents/produktarksmartstyring.pdf>

⁴⁶ <http://www.energilaben-dyroey.no/index.php>

⁴⁷ <http://www.trondheim.kommune.no/framtidensbyer/>

⁴⁸ Telenor Group Presentation Q4 2010

5. Possible ways forward

“IKT er i dag antagelig den viktigste driveren for bærekraftig økonomisk vekst, og en forutsetning for innovasjon og fornying i både offentlig og privat sektor. IKT er også et sentralt verktøy for å løse klima-utfordringene. IKT skaper nye muligheter og nye forventninger til elektronisk forvaltning. IKT gir grunnlag for økt produktivitet i næringslivet og den er en drivkraft for utvikling av nye næringer, særlig innen tjenesteyting.”

Rigmor Aasrud,
Minister of Government Administration, Reform and Church Affairs,
Computerworld 26. February 2010

5.1. Organisational

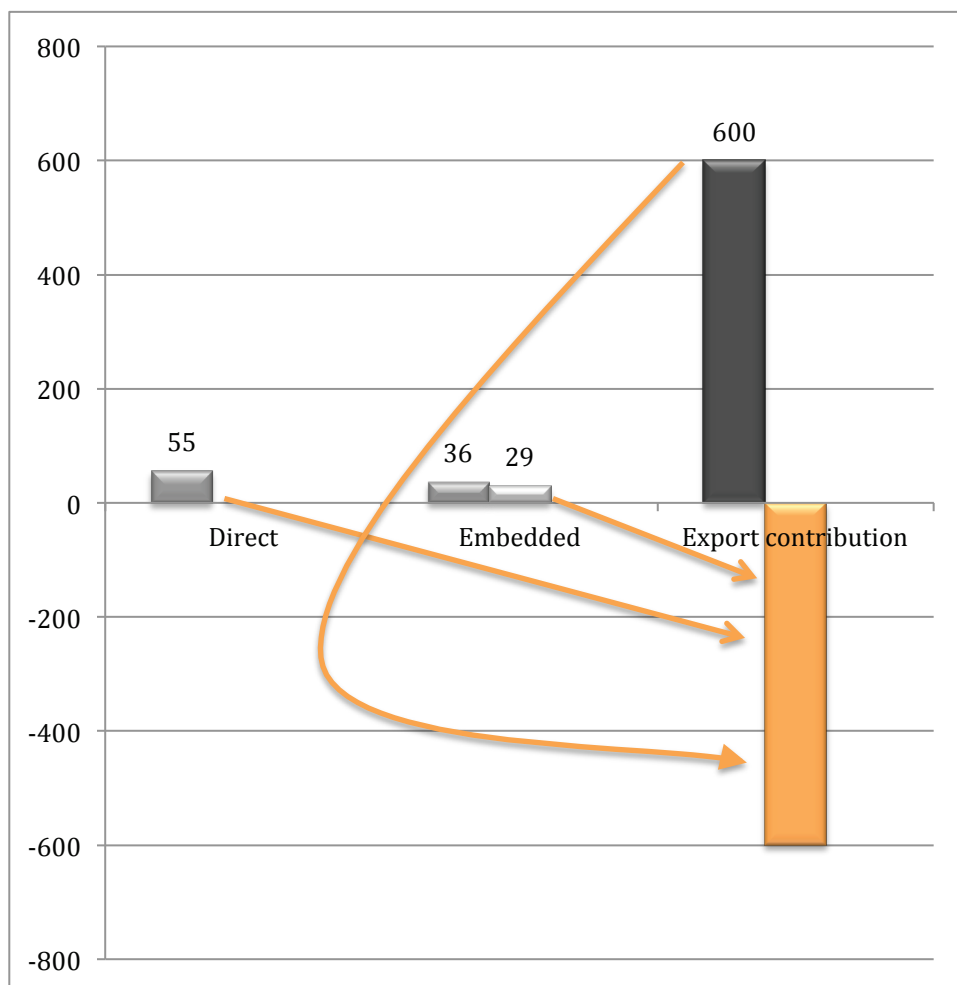
- **Introduce a sector/service matrix to guide the next generation of low-carbon solutions and innovation support.**
 - Review current climate policies, based on incremental reductions within existing sectors, in relation to the need for 80-90% reductions and innovative ways to provide the services society needs.
 - Identify leaders in Norway that already have begun to deliver and use transformative solutions and then develop mechanisms to acknowledge as well as support these leaders.

		Service				
Sector		Food/nutrition	Work commuting	Lighting	Optimal indoor temperature	Meetings
	Transport	Organic beans transported by ship <i>Meat transported by air</i>	Electric public transport <i>Fossil cars</i>			Electric public transport <i>Air travel</i>
	Retail	Selling organic beans <i>Selling GMO beef</i>		Low-carbon solutions for the poor <i>Excessive lighting for the rich</i>	Efficient appliances and smart lifestyle information <i>Inefficient appliances</i>	
	Chemical/ Biomimicry	Developing organic farming practises <i>Developing GMO-Beef</i>	Fiber optic cables for teleworking and batteries for electric cars		Insulation material for system solutions <i>Incremental improvements in unsustainable buildings</i>	
	Steel		Road construction			
	ICT	Information about low-carbon food	Teleworking <i>Design tools for road construction</i>	Light controls and software to design buildings	Smart temperature control and building design	Video conferencing <i>Online tools for frequent flying</i>
	Coal/oil/gas	<i>Input to fertilisers for the soy that the cattle eat, fuel for planes that fly the meat, etc.</i>	<i>Oil for fossil cars</i>	<i>Coal power for inefficient lighting</i>	<i>Coal and oil to heat/coal inefficient buildings</i>	<i>Fuel for planes</i>
	Solar and wind	Supply energy for organic agriculture and food preparation	Supply energy for smart buildings	Integrated solar PV with LED and batteries	Integrated with smart windows and smart design	Supply IT equipment and high speed trains with energy

Figure 19: A Sector/Service Matrix with illustrative examples of sustainable ways to provide services (**bold**) and unsustainable ways (*italic*).

➤ **Establish a “Global Net Positive Norway” Climate taskforce**

- Establish a baseline for Norway’s global net climate impact (i.e. the result when emission reductions due to export from Norway of low-carbon solutions, are subtracted from the emissions due to export from Norway of high-carbon goods and services, such as oil).
- Create an ad hoc working group, with members from all relevant ministries, for transformative solutions with the aim to develop a strategy and implementation plan for Norway as a “net-positive country”. A reference group with national as well as international stakeholders should also be established to ensure broad collaboration and access to best practice.
- Identify solutions with multifunctional benefits (employment, equity, other environmental benefits such a reduced water use, etc). Ensure that all relevant stakeholders have the possibility to provide input in order to ensure that solutions are implemented that are demand driven.⁴⁹
- Use current activities related to the direct emissions, the embedded emissions and the impact from the oil cluster (re-investments and the oil fund) to see how Norway could help to reduce >600 million tonnes around the world.



⁴⁹ Privacy and ownership issues are important to discuss and experts studies in these areas should be included in the work, e.g. <http://www.fao.no/pub/rapp/20166/20166.pdf>

Figure 20: Million tonnes of CO2 from different aspects of Norway's economy and an overview of the current and potential climate impact of Norway illustrating the significant potential and need for transformative low-carbon ICT solutions.

5.2 Eight possible initiatives

Below are eight possible initiatives that could be initiated by Norway. Most of them require new thinking and collaboration rather than a lot of money to be implemented.

1. Norway 350: Aiming for the moon

As a contribution to a “Global Net Positive Norway” a project could be initiated that start by looking at the opportunities. Over the next 30 years more than 350 trillion dollars will be invested to provide people in cities with basic services such a lighting, communication, a comfortable temperature, etc. Norway could make a 350 trillion dollar opportunity assessment for global low-carbon (ICT) solutions to see how much of this money that could be invested in low-carbon solutions exported from Norway. Such an assessment could be linked to a report identifying transformative solutions from Norway that can help reduce global emissions with at least 350 million tonnes (the equivalent of the emissions from the export of Norwegian oil) when they are exported. This would help the world towards a 350ppm scenario.

The 350 trillion dollars that urban areas will spend in the next 30 years to deliver basic services such a light, comfortable temperature, travel/communication must shift from fossil fuel investments to sustainable ways to provide services.⁵⁰

A focus on export could help identify investments in solutions that help deliver energy efficiency in Norway as a priority for a low carbon strategy (with global impact), even if these solutions do not save much CO2 due to the low grid carbon in Norway. Smart grid/building solutions are of particular importance and collaboration with other world leading projects should be encouraged.⁵¹

2. Transformative collaboration platform

Create an open collaboration platform for transformative solutions. A “collaboration and synergy index” could be developed to track how ministries as well as sectors are collaborating to develop and implement transformative solutions.

This platform could explore the use of technologies that increase transparency, such as RFID, and new business models that this transparency could support.

Interesting cases such as Posten Norge where they have used a “service approach” that support a low-carbon business model, could serve as inspiration for transformative business change in other areas.⁵²

Evaluation of earlier cross-ministerial initiatives should be carried out to see how

⁵⁰ <http://dpamlin.blogspot.com/2010/03/new-study-350-trillion-available-for.html>

⁵¹ For smart grids and buildings Asia is a key player and collaboration with projects like Baoding in China and Jeju in South Korea could be explored <http://www.smartgrid.or.kr/Ebook/JejuTestBed.pdf>

⁵² <http://www.idg.no/computerworld/article192027.ece?nl=1>

many tonnes of CO₂, millions of dollars in revenues, new jobs, dynamic effects, etc the supported solutions have resulted in. In 2009 a decision was for example made to invest 100 million NKR in environmental technology in collaboration between the Ministry of Environment and the Ministry of Industry.⁵³

3. **“Aging for innovation”**

Initiate a global “Aging for innovation” initiative. The demographic changes that are taking place will require societies to fundamentally rethink how they are organised. In many countries the aging population is seen as a problem with collapsing pension funds, exploding health costs and involuntary unemployment. Norway could take the lead in a global “Aging for innovation” initiative where the demographic change is seen as a driver for innovation to address climate change.

4. **Sovereign wealth funds for transformative change**

Launch a global sovereign wealth funds initiative for transformative change. Norway could launch an initiative for investors, with specific focus on sovereign wealth funds and how they can support transformative solutions.

This could be initiated by Norway, doing something creative, and it does not have to be difficult at all. Posing the following two questions (and analysing the feedback) to the companies that the Norwegian wealth fund invests in would help serious companies a lot. The questions should support data collection by initiatives like CDP and the GHG protocol.⁵⁴

- o Asking companies to report how much they have helped reduce emissions in society with their products and services (not only the Scope 1-3 emissions).

- o Asking companies to provide information about what transformative (ICT) solutions they can provide which nine billion people eventually can make use of, (as opposed to solutions which are not sustainable as they are not applicable on a global scale without destroying the planet).

5. **Young entrepreneurs for global solutions**

A new generation see ICT as an integrated part of life and have a deep understanding of the challenges society face. Norway could help launch the first young entrepreneurs for global solutions initiative using Web 2.0 and mobile applications.⁵⁵ For example a “Code of the year”, where a price is given to the best low-carbon software, could be launched at Rio+20 in 2012.⁵⁶

6. **Public procurement for transformative solutions**

Review the rules for public procurement and explore the possibility to:

⁵³ <http://www.regjeringen.no/nb/dep/md/pressemeldinger/2009/100-millioner-kroner-til-miljoteknologi-.html?id=574781>

⁵⁴ An overview of how to assess positive contributions from companies and references to existing initiatives can be found here: http://www.transformative-solutions.net/files/LCL_Transformative_Calculations-Final.pdf

Norway's SWF could do a lot more and this report provided an overview of some options: <http://dpamlin.blogspot.com/2008/09/investments-for-low-carbon-economy-new.html>

⁵⁵ For more information about web 2.0 and mobile applications for sustainable development please see:

⁵⁶ This could link to existing initiatives such as: <http://www.fremtidskonferansen.no/fremtidspriiser/>

- a. Base procurement on service, not products. E.g. smart meetings should be the request, not low-carbon air flights (so that virtual meetings can be included).
- b. Ask for net positive ICT solutions so that providers of servers, mobile devices and software are required to provide information about the impact of their solutions.

7. Establish a low-carbon feedback mechanism

One of the main challenges with transformative low-carbon solutions is that they help save significant amounts of resources (time and money) on top of the CO₂ savings. This is very good if these resources are re-invested in more low-carbon solutions. If however these resources are invested in high-carbon solutions, e.g. if people telework and use the money and time they save to invest in SUVs the overall impact will be negative. Similar if a government for example support teleworking, road investments can be reduced. This money should not be invested in fossil fuel extraction, but should rather be invested in more smart solutions such as e-health.

8. 9 billion people global sustainability filter

A filter should be introduced that require stakeholders, including the government itself, to measure the global impact of all major investments and initiatives. In addition to measuring domestic CO₂ reductions, the possibility to provide 9 billion people with basic services should also be used as an indicator.

Norway could be the first country in the world to use a 9 billion people sustainability filter for climate, industrial and export policies. This filter would help clarify what solutions are truly sustainable by assessing if 9 billion people could use them in a sustainable way. A “9 billion sustainability filter” could help Norway to avoid high-carbon lock-in and negative rebound effects.

APPENDIX

Appendix 1

Contacted persons and interviews in Norway (chronological order)

Randi Hjorthol, Forskningsleder i Transport Økonomisk Institutt (TØI):

28th January: Reply that she is not an expert and not aware of anyone that is.

Kristin Linnerud, klimaendringer og kraftsektoren, politiske virkemidler og tilpasninger, Cicero

29th January: Written input and suggestions for experts to contact.

Svein Ølnes, Forskar og gruppeleiar IT, Vestlandsforsking

30th January: responded with recommendation and forwarded request to: Carlo Aall, forskingsleiar for miljø- og klimaforsking på Vestlandsforsking.

Benedicte Fasmer Waaler, Prosjektansvarlig for grønn it, IKT-Norge

31st January: Interview

Tarje Bjørgum, Politisk rådgiver, Abelia

1st February: Interview

Philip Mortensen, seniorrådgiver, Avdeling for klima og forurensning

Miljøverndepartementet/Ingvild

9 February: Interview

Jan Kristensen, Director Climate Change, Corporate Responsibility, Telenor

11 February: Interview

Stig Aga Aandstad, Senior Adviser, Climate and ICT strategy

11 February: Interview

Berit Lid Scharff, Tandberg/Cisco

14 February: Replied that they could not respond to the survey

Knut Eirik Gustavsen, direktør for forretningsutvikling innenfor energy, TIETO

18 February: interview

Heidi Carin Dreyer, Professor/Senior researcher, Department of production and Quality

Engineering/Logistics, SINTEF

21 February: interview

Glen Peters, Senior Research Fellow, Cicero

21 February: Data provided regarding embedded and exported emissions

Trine Lise Sundnes, sekretær og politisk ansvarlig for området klima, LO

23 february: Interview

No response

> **Lars Haltbrekken**, Naturvernforbundet 31st January: Replied that Holger Schlaupitz will get back, but no response

> **Birgit R. Krogstie**, NTNU, no response

Contacted persons and interviews outside Norway (alphabetical order)

- > Charles X. Yang, founder and CEO of Nature Information Science and Technology Ltd, China
- > Chris Preist, Reader in Sustainability and Computer Systems at University of Bristol
- > Gary Cook, Senior IT Policy Analyst at Greenpeace International
- > Gilles Berhault, Founder, ACIDD, Association Communication and Information for Sustainable Development
- > Jose Maria Diaz Batanero, Policy Analyst, International Telecommunication Union
- > Luis Neves, Chairman of the board, GeSI
- > Niven Huang, Secretary General, BCSD-Taiwan
- > Samantha Putt del Pino, Co-director: Business Engagement in Climate and Technology, WRI
- > Satoko Ekberg , Director, E-Square Inc, Japan
- > Seema Arora, Principal Counsellor, Confederation of Indian Industry
- > Sofia Holmgren, Enheten för IT-politik, Näringsdepartementet, Sweden
- > Vin Sumner , Owner, Clicks and Links, UK

Appendix 2

Lists of leading Climate/ICT countries⁵⁷

The Networked Readiness Index 2009–2010

Country/ Economy	Rank	Score	Rank within income group*	
Sweden	1	5.65	HI	1
Singapore	2	5.64	HI	2
Denmark	3	5.54	HI	3
Switzerland	4	5.48	HI	4
United States	5	5.46	HI	5
Finland	6	5.44	HI	6
Canada	7	5.36	HI	7
Hong Kong SAR	8	5.33	HI	8
Netherlands	9	5.32	HI	9
Norway	10	5.22	HI	10

⁵⁷ <https://members.weforum.org/pdf/GITR10/TheNetworkedReadinessIndexRankings.pdf>

Appendix 3

Examples of how different countries included ICT in their national communications

The communications can be found on UNFCCC webpage.⁵⁸

1. Japan

Clear differentiation between 2% and 98%, relation to infrastructure, strategy and targets at different places of the report. For example targets for teleworking.

(c) Promotion of Telework and Other Transport Substitution by Information and Communications Technology						
Promotion of telework and other transport substitution by information and communications technology	Teleworking population (10,000 persons)		-Steadily implementing the 36 items listed in the Action Plan to Double the Number of Teleworking Population (established by the Ministries Concerned Liaison Conference on Teleworking Promotion and approved by the IT Strategy Headquarters on May 29, 2007; Cabinet Secretariat, Ministry of Internal Affairs and Communications, Ministry of Health, Labour and Welfare, Ministry of Economy, Trade and Industry, Ministry of Land, Infrastructure, Transport and Tourism, and the other ministries and agencies)		(10,000t-CO ₂)	
	2008	approx. 970			2008	approx. 37.8
	2009	approx. 1140			2009	approx. 43.9
	2010	approx. 1300			2010	approx. 50.4
	2011	approx. 1460			2011	approx. 56.5
	2012	approx. 1630			2012	approx. 63

~Teleworking population (20% of employees: approx. 13 million in 2010)

2. Denmark

An overview of the national strategy in an appendix

10) GREEN IT

In April 2008, The Ministry of Science, Technology and Innovation of Denmark published an Action Plan for Green IT. IT is responsible for more than two percent of the world's total emission of CO₂.

Ministry of Science, Technology and Innovation of Denmark

Denmark has repeatedly been chosen as the world's leading IT nation, and the Danish IT infrastructure is world class. Therefore, Denmark is well suited to take the lead in the battle against climate change – also in the field of IT. The Action Plan from the Ministry of Science, Technology and Innovation aimed to make it easier for citizens, businesses and public authorities to choose energy-efficient IT solutions. At the same time, the Action Plan set out to promote the development of IT-based solutions that could help to reduce overall energy consumption.

The Action Plan for Green IT from the Ministry of Science, Technology and Innovation pursued two main objectives:

1. Citizens, businesses and public authorities' use of IT should be greener. The public must grow better at using IT in an environmentally friendly way, and it should be made easier for the public to choose energy-efficient IT products. Corporate IT use must become greener and Green IT must be incorporated into corporate social responsibility, along with other environmental issues. Finally, the public authorities need to grow better at saving power and choosing energy-efficient IT solutions.

2. IT should help bring about a reduction in overall energy consumption. Smart IT solutions can, in many instances, help to reduce energy consumption and thus CO₂ emissions. For example, intelligent management of electrical devices in businesses and in private homes can ensure that energy consuming equipment is not switched on when not in use. Furthermore, the use of electronic mail and eGovernment by public authorities can save both paper and transportation.

⁵⁸ http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/4903.php

3. Finland

Linking ICT to the most innovative parts of the national communication

Box 8.2

Climate Bonus: Combining carbon footprinting, monitoring, feedback and rewards, and demonstrating the potential of green ICT

The implementation of ambitious climate policies needs new instruments and approaches that go beyond the current portfolio of policies and measures. In the Climate Bonus project (2008–2009), a feedback and reward system for households and retailers was developed by a consortium of five Finnish research institutions and six companies. The piloted ICT service enables consumers to monitor and follow the accumulated greenhouse gas emissions of their household purchases. Users of the service also have the possibility to compare their results with target levels and other users of the system. They can acquire bonus points (credits), e.g. on the basis of a reduction of the greenhouse gas intensity.

The demonstration version of the service covers emissions from foodstuffs, transport fuels and services, energy consumption at home, and a category "other consumption". It combines several approaches and data sources (life-cycle analysis, input/output analyses and emissions trading).

Foodstuff purchases are registered with the service automatically through a special system (www.nutritioncode.com) that uses a dedicated key card and the information systems of the Kesko retail chain. The rest of the purchases are recorded manually via a computer interface or using the optical barcode recognition capabilities of Nokia mobile phones. The project also introduced the basic structure of a system to produce data for generating product-oriented "certified carbon footprints".

Feedback from the pilot has been encouraging: consumers believed that the use of a monitoring and feedback system for consumption-induced greenhouse gas emissions could change the consumption patterns of households and reduce greenhouse gas emissions from consumption. The authors of the study believe that feedback systems like Climate Bonus could activate significant voluntary emission reduction potential if disseminated for extensive use.

Appendix 4

The two first months of 2011: The most ICT dominated ever?

January 1: Foreign affairs Jan/Feb 2011 Cover: "The Political Power of Social Media"⁵⁹

Discussion of the political impact of social media has focused on the power of mass protests to topple governments. In fact, social media's real potential lies in supporting civil society and the public sphere -- which will produce change over years and decades, not weeks or months.

Still they should be more careful to not confuse actual political power with "slacktivism".⁶⁰ Labour unions and grassroots organisation that have had a real impact have often worked years, or even decades, but in today's media climate it is easy to be excited over the latest headlines and click a few "like" buttons.

January 23: Illustration of global scientific collaboration⁶¹

A global map of scientific collaboration between researchers, published 23rd of January 2011 by Olivier H. Beauchesne.

January 28: Amazon.com sell more e-books than paper books⁶²

Amazon wrote that in all of 2010, it sold 15% more Kindle e-books than paperbacks, or as Wired calls them "dead-tree books"⁶³, and three times as many Kindle e-books as hardcovers. The ICT analyst firm Gartner estimate that e-books account for about 10% of all book sales in North America.⁶⁴ The newspaper Guardian reflected on the current trend and concluded "at this rate it can't be too long before Gutenberg's offspring is dethroned."⁶⁵

January 31: the price of oil reached US\$100 a barrel.⁶⁶

February 2:⁶⁷ AT&T* debuted a multi-million dollar B2B advertising campaign

In this AT&T showcase how it is delivering transformative network-based and mobility solutions to companies that are redefining how people everywhere live and work.

Examples showcased in the campaign include:

- * Machines that have a voice, so they can tell headquarters when they need refilling.
- * Money that works smarter, so financial institutions can turn dreams into realities.
- * Medical histories that can be brought to life, so doctors have access to a patient's medical history even when away from home.

February 2: Wired (UK) cover: Your Life Torn Open: What the end of privacy means for you⁶⁸

"You have zero privacy anyway," Scott McNealy, chairman of Sun Microsystems, famously declared back in 1999. "Get over it." And that was long before Facebook, Twitter, Quora and countless other social networks urged us to share our real-time thoughts, our location, even our knowledge with whichever strangers happened to be paying attention. So where does all this openness leave us today?"⁶⁹

February 7: The Resource Efficiency Alliance (REA): Why Europe will soon lose its self-proclaimed green economy leadership.⁷⁰

⁵⁹ <http://www.foreignaffairs.com/issues/2011/90/1>

⁶⁰ http://neteffect.foreignpolicy.com/posts/2009/05/19/the_brave_new_world_of_slacktivism

⁶¹ <http://olihb.com/2011/01/23/map-of-scientific-collaboration-between-researchers/>

⁶² <http://phx.corporate-ir.net/phoenix.zhtml?ID=1521090&p=irol-newsArticle&c=176060&highlight=>

⁶³ <http://www.wired.com/epicenter/2010/07/amazon-more-e-books-than-hardcovers/>

⁶⁴

http://www.computerworld.com/s/article/9207019/Amazon.com_touts_more_e_book_sales_than_paper_backs?taxonomyId=12

⁶⁵ <http://www.guardian.co.uk/world/richard-adams-blog/2011/jan/28/amazon-kindle-ebook-paperback-sales>

⁶⁶ <http://in.reuters.com/article/2011/01/31/us-markets-oil-idINTRE6BD61U20110131>

⁶⁷ <http://www.att.com/gen/press-room?pid=18979&cdvn=news&newsarticleid=31538>

⁶⁸ <http://www.wired.co.uk/magazine/archive/2011/03>

⁶⁹ <http://www.wired.co.uk/magazine/archive/2011/03/start/from-the-editor>

⁷⁰ <http://www.epe.be/files/GreenRaceandresource-efficientEurope.pdf>

"The Green Race is on all over the world and China's green race is off to a good start. In this framework "it is highly doubtful that the EU will preserve its self-proclaimed green economy leadership with the resource efficient Europe flagship initiative in its present form. We have just a few months to go, to the Rio + 20 Conference, to complete the Commission's approach with much more ambitious and systemic initiatives" underlined Mr. Tom Vereijken, on behalf of the Resource Efficiency Alliance Members, assessing the Commission proposal."⁷¹

February 8: WikiLeaks cables: Saudi Arabia cannot pump enough oil to keep a lid on prices⁷²

Guardian wrote an article based on the latest WikiLeaks cables where they said that US diplomat was convinced by Saudi expert that reserves of world's biggest oil exporter have been overstated by nearly 40%.

February 12: Geohot post a rap against Sony on YouTube that goes viral.⁷³

The use of YouTube to spread political messages are increasing and the conflict between Geohot and Sony is just the latest example. One very good example on when the freedom of speech and transformative example is presented in a rap format is Juice Media Rap News, with Robert Foster.⁷⁴

February 12: The Economist cover: Print me a Stradivarius: The manufacturing technology that will change the world.⁷⁵

"Just as nobody could have predicted the impact of the steam engine in 1750—or the printing press in 1450, or the transistor in 1950—it is impossible to foresee the long-term impact of 3D printing. But the technology is coming, and it is likely to disrupt every field it touches. Companies, regulators and entrepreneurs should start thinking about it now. One thing, at least, seems clear: although 3D printing will create winners and losers in the short term, in the long run it will expand the realm of industry—and imagination."⁷⁶

February 14: Illustration of the Twitter networks in Egypt

"Twitter users are said to influence each other if they follow each other. These relationships are shown with lines. Individual users are placed near the individuals they influence, and factions near the factions they influence. Node size represents the extent of a user's influence across the entire network. Color, meanwhile, is based on the language they tweet in — a choice that itself can be meaningful, and clearly separates different strata of society."⁷⁷

February 16: Trash|Track won NSF International Science & Engineering Visualization Challenge⁷⁸

"Many people know about the supply chain. They care about whether their fruit is organic, whether their chickens are freerange, whether the products they buy are domestically manufactured or imported. But the other end of the consumer chain--where all the used products go after they're dumped in the trash--is murkier."⁷⁹

February 16: IBM's computer "Watson" Wins on 'Jeopardy!'.⁸⁰

"Traditionally, economists have argued that while new forms of automation may displace jobs in the short run, over longer periods of time economic growth and job creation have continued to outpace any job-killing technologies. For example, over the past century and a half the shift from being a largely agrarian society to one in which less than 1 percent of the United States labor force is in agriculture is frequently cited as evidence of the economy's ability to reinvent itself.

That, however, was before machines began to "understand" human language. Rapid progress in natural language processing is beginning to lead to a new wave of automation that promises to transform areas of the economy that have until now been untouched by technological change."⁸¹

⁷¹ <http://www.epe.be/files/GreenRaceandresource-efficientEurope.pdf>

⁷² <http://www.guardian.co.uk/business/2011/feb/08/saudi-oil-reserves-overstated-wikileaks>

⁷³ http://www.youtube.com/watch?v=9iUvuaChDEg&feature=player_embedded

⁷⁴ http://www.youtube.com/watch?v=hl4NlA97GeQ&feature=player_embedded

⁷⁵ <http://www.economist.com/node/18114327>

⁷⁶ <http://www.economist.com/node/18114327>

⁷⁷ <http://www.visualizing.org/stories/visualizing-arab-revolution>

⁷⁸ <http://senseable.mit.edu/trashtrack/>

⁷⁹ http://www.nsf.gov/news/special_reports/scivis/winners_2010.jsp#info_graphics

⁸⁰ <http://www-943.ibm.com/innovation/us/watson/>

⁸¹ <http://www.nytimes.com/2011/02/15/science/15essay.html?partner=rss&emc=rss>