Fairconditioning 2014-2017

Cooling India Efficiently and Sustainably

Programme Description

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Noé21 is the French acronym for New Economic Orientation for the 21st Century
Independent NGO specialized in solutions to climate change

Member of
European Environmental Bureau EEB, Brussels
Climate Action Network-Europe CAN-E, Brussels
Climate Alliance (Switzerland), Zurich
Accredited NGO to the UNFCCC, Bonn

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Executive Summary

This 3-year programme (2014-2017) set in India emanates from Noé21, a UN registered, not-for-profit NGO headquartered in Geneva. The goal motivating Noé21 is to identify, evaluate, and promote powerful as well as realistic solutions to reduce greenhouse gas (GHG) emissions, using a catalytic approach.

In Switzerland, Noé21 has been active in fostering the deep retrofitting of the building stock to reduce the outstanding contribution to global warming from heating buildings. In India where the construction of homes and buildings is thriving, Noé21 identified a large potential for avoiding future GHG emissions in the related cooling sector. Buildings and homes designed with no regard to local climate and limited, costly energy reserves are a direct cause of increased mechanical cooling demands and otherwise avoidable energy costs, at both the individual and national levels, as well as environmental harm that is irreversible.

The amount of energy (and related GHG emissions) necessary to cool Indian building interiors in the years ahead will depend on how they are designed and built today and in the coming years, the technology used for cooling, as well as the behaviour and operation of the equipment by occupants of air conditioned spaces. The potential to reduce the energy demand from buildings in India is huge considering this sector's growth rate and the current lack of regard for how much energy and GHG emissions could be avoided. The energy demand to cool interiors could be drastically reduced, provided actionable information, financial models, and relevant tools are made available at the appropriate levels of this complex chain, from the training of architects to the actual construction site, from the implementation of green building codes to the choice of the most efficient cooling technology on the market.

Noé21 partnered in June 2012 with cBalance, an Indian environmental engineering Social Enterprise founded by an Ashoka Fellow, who matched Noé21's deep commitment in the field of climate change mitigation and promoting resilience to climate change throughout India.

The Pilot phase completed in June 2013 concentrated on phasing out air conditioners using synthetic refrigerants with very high global warming potential and phasing in energy efficient ACs charged with low global warming potential natural refrigerants (propane).

Thanks to the financial support from the State of Geneva, the Oak Foundation and Noé21, this Pilot phase engaged hotel chains, banks, builders, and college campuses on a Voluntary Adopter programme for Natural Refrigerant ACs, stimulated MBA students to define commercially viable financial models to retrofit homes and businesses with the ACs, collaborated with consumer and policy advocacy groups to amplify awareness of this technology, and made architectural colleges and AC consultants aware of the Energy-Efficiency issue in the choice of AC models.

Experience gained during the Pilot phase has led us to the formulation of fields of intervention in addition to the end-of pipe option of AC choice. Bearing this in mind, the Pilot phase team at Noé21 in Geneva and cBalance in India have devised a scaled-up Second Phase of the programme including beginning-of-pipe interventions to reduce energy demand.

The Fairconditioning programme was designed bearing in mind two main lessons learned during the Pilot phase:

1. Most stakeholders that Noé21 and cBalance have worked with are showing a notable interest in taking energy-efficiency on board as a driving force for their future development. The scope of the programme will reach urban areas having the highest built environment expansion rates (commercial and residential) in India.

2. The potential for implementing energy efficiency in Indian interiors goes well beyond the type of AC chosen to reach interior thermal comfort. The need for energy to cool interiors mechanically is directly linked to building design and operational behaviour. Fairconditioning therefore addresses the root causes of cooling demand by stimulating upstream issues.

Fairconditioning launched in June 2014 extending to eight urban areas: Mumbai (Maharashtra), Delhi (National Capital Territory), Kolkata (West Bengal), Chennai (Tamil Nadu), Bangalore (Karnataka), Pune (Maharashtra), Ahmedabad (Gujarat), and Hyderabad (Andhra Pradesh).

Two categories of intervention will be carried out through this programme:

Beginning-of-pipe interventions

Student curricula in engineering and architecture education will be enhanced so that students graduate with the needed knowledge on reaching indoor thermal comfort in the most efficient manner. Fairconditioning will help SMEs to implement Energy Efficiency best practices to reduce heat-loads. Enlisting Technology Ambassadors aims to catalyse interest and enhance confidence among the technical decision-makers in commercial and industrial enterprises (cluster-consumers of split-unit ACs and owners of large commercial buildings e.g. banks, hotels, IT offices, refrigerated shipping containers). They will be empanelled into a building energy modelling advisory service platform under the programme umbrella to facilitate beginning-of-pipe approaches for enhancing building Energy Efficiency.

End-of-pipe interventions

Such as enlisting SMEs, large corporations and administrations onto the Voluntary Adopters programme whereby AC thermostats are "Upped by 2°C, dress codes are implemented to reduce cooling demand and, in hot and dry climates, efficient evaporative cooling techniques are favoured. Consumer Ambassadors are also trained to increase the uptake of Natural Refrigerant ACs. For applications where Air Conditioning is unavoidable, the programme will aim to promote the use of Natural Refrigerant-based AC technologies through AC consultants who are primary influencers in the AC purchasing decision-making process for large developers. Fairconditioning will engage with the Indian Green Building Council and the sustainable building movement in India to encourage recognition of the importance of Natural Refrigerants in reducing GHG emissions from India's buildings. Finally, the Second Phase of Fairconditioning will go well beyond room ACs (the focus of the Pilot programme) and will, for the first time in India, create international knowledge transfer and technology exchange related to Natural Refrigerant AC technology for centrally air-conditioned buildings.

In India, Fairconditioning aims to avoid dire energy insecurity, inequitable energy access, and urban climate change adaptation and resilience concerns. It also directly addresses climate impacts through reductions of GHG emissions from buildings compared to the business-as-usual path. Aiming at this is realistic and vital; all the required solutions are readily at hand. Knowledge, funds and dedication are at hand in India but are not tapped because of a current lack of intent. The Fairconditioning programme develops this intent through several means in bottom-up and top-down approaches, reaching out to key stakeholders in the field of indoor thermal comfort.

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WELCOME TO FAIRCONDITIONING INDIA

2013 marked the 10th anniversary of Noé21. We have grown from having a Swiss and European focus for our climate change campaign to scaling our experience and expertise to Mumbai in the State of Maharashtra and now to 8 large urban areas in India. This programme description details FAIRCONDITIONING, the scaling of our Indian operations from 2014 to 2017.

In June 2013, Noé21 and its Indian partner cBalance completed a successful one-year Pilot Phase of FAIRCONDITIONING, a programme designed to help cool India efficiently and sustainably. With a focused bottom-up approach, our partnership gained momentum thanks to a motivated stakeholder network on the ground working to phase out inefficient air conditioning units charged with fluorocarbons: potent industrial global warming gases (PIGGs) responsible for 12.9% of man-made global warming[1]. The programme concentrated on phasing in a new type of energy-efficient air conditioner charged with the natural refrigerant - propane. The Mumbai programme is now scaling to 8 Indian cities during a three-year Second Phase that started in June 2014.

1 Climate Change 2007 : The Fourth Assessment Report of the IPCC

How this all started…
In collaboration with other NGOs, in April 2010, Noé21 submitted a request to the United Nations Framework Convention on Climate Change (UNFCCC) to modify the methodology that provided for the destruction of industrial gases (HFC-23) in exchange for tradable carbon credits. Fellow climate advocates coined these types of carbon credits as "rotten". **Noé21 built a strong case to demonstrate that carbon credits from HFC-23 profit needed to be reduced in order to prevent a perverse incentive to produce more HFC-23. Our proposed methodology was adopted by the UNFCCC and was implemented on April 1st, 2013. The European Commission also banned these HFC-23 offsets from its Emissions Trading Scheme. The Noé21 team's relentless drive led to a sustainable improvement in policy at European level.** This empowered us to aim at reducing end-of-pipe consumption: replacing appliances still charged with fluorinated gases such as air conditioners.

The Fairconditioning Pilot phase delivered three sustainable outcomes, (1) it raised awareness among a community of key Indian consumers, architects, academia and real estate developers about the comparative benefits of Natural Refrigerant ACs, (2) it fostered research and proposed sound business cases for both retrofitting and new constructions, and (3) it provided technical and behavioural toolkits for attaining sustainable indoor thermal comfort with little or no negative effect on the climate and a downward push on energy bills.

Noé21's Pilot programme success has relied largely on the skills and motivation deployed by its partner in India: cBalance of Mumbai. cBalance is a young and dynamic environmental engineering company. Its founder, Ashoka Fellow and cBalance Manager, Vivek Gilani, and his team successfully completed the Pilot Phase 'Campaign for Natural Refrigerants'. cBalance will be the main implementer of the scaled Fairconditioning programme from 2014 to 2017. The International Solidarity Bureau of the State of Geneva and the Oak Foundation whom we thank warmly for supporting this ground-breaking innovation financed the Pilot phase.

Head of Programme, Philippe de Rougemont and the whole Fairconditioning team join me in encouraging your support and thank you sincerely for considering financial or in-kind participation for the Second Phase. **We look forward to engaging with you to identify how best your organisation can be an impactful catalyst for sustainable change in the way that India cools its interiors. The clock is ticking, demand for thermal comfort is growing rapidly throughout the country, and this is resulting in power outages and an alarming increase in demand for polluting coal-fired power plants across the country.**
The time to act is now.
We invite you to share our vision.

Thank you.

Chaïm Nissim, Noé21 Founder

I. Introduction

Our planet's oceans, vegetation, and soil can absorb 3Gt of carbon emissions per year, a threshold first exceeded in 1968. In 2009, carbon emissions reached 6.6 Gt, more than double what scientists agree the earth can hold. In the absence of action to counter this perilous trend, carbon emissions will rise to 14 Gt by 2050. For the planet and its inhabitants, our children and generations to come, this means accelerating desertification, more natural disasters, reduced crop yields, and serious public health implications such as heat-related infectious diseases.

In early 2003, Noé21's founders began to assess the most powerful and politically feasible solutions - low hanging fruits - to reduce energy demand and related GHG emissions. The Noé21 team was busy with climate change solutions awareness activities in Switzerland on ecological tax reform and Energy Efficiency during organisation's first years. The globalisation process and the carbon credit CDM market turned climate activists' and researchers' attention towards the mountain of additional GHG emissions expected from emerging economies in the coming years. A large portion of these emissions are avoidable, in terms of waste and inefficient energy consumption.
The first generation of industrialised nations off-shored manufacturing activities to cheap labour and less regulated countries such as China and India. This is where programmes and campaigns should be heading, so that these countries are helped to leap frog directly to an energy efficient economy. Choosing the business-as-usual path of development would lock these countries in a model of energy wastage and GHG emissions on a dramatic scale, mainly in the form of buildings designed with no attention to subsequent energy consumption levels.

Air conditioning is responsible for the major part of world F-gas emissions as well as for the largest part of energy demand by households in both hot and humid and hot and dry climates.

The cooling and refrigeration sectors are the main drivers of energy demand in India. Air conditioning is responsible for the major part of world F-gas emissions as well as for the largest part of energy demand by households in both hot and humid and hot and dry climates. In early 2012 with assistance from the German Development Agency GIZ, a new generation of ACs was introduced into India that run on natural gas HC-290 (Hydrocarbon); these ACs are 20% more energy-efficient. Even though this new generation of ACs has a mere two-year payback period (case of a commercial enterprise using an AC 3000 hours per year) for a 10% increase in initial cost, and despite the fact that these units reduce running costs by at least 20% as compared to best-in-class ACs available
today, uptake needs to be encouraged proactively so that this alternative becomes known to consumers and decisive sectors of the economy. FAIRCONDITIONING has taken up the challenge and is leading the way to create demand for the phasing-out of synthetic super greenhouse gases (GHG) in India by spearheading the uptake of new ways to cool interiors.

Climate change is accelerating globally, but a combination of tools is available to drive the current levels of emissions into a downward spiral: consumer education and change in architecture school curricula, and accelerating the uptake of energy efficient appliances. Fairconditioning is an audacious programme leveraging all the available tools, seeking to stimulate the use of climate-friendly alternatives to high-emission ACs in India.

Why India? Noé21 is leveraging its experience and know-how gained in Switzerland and Europe on climate change mitigation and resilience to the fast-paced developmental context in India. India is one of the world's largest emitters of CO_2 and ranks among the world's lowest in environmental performance.

Amongst several persons and organisations the Noé21 team reached out to and befriended during the elaboration of this programme, M. Rajendra Shende at the time Head of UNEP's Ozone Unit, encouraged and counselled Noé21 on the project. With his deep knowledge of the issue as well as of India, his counselling was very influential. M. Janos Mate, senior campaigner from Greenpeace International told us how the indoor cooling sector was the highly strategic Energy-Efficiency sector to target and also the remaining sector still using highly climate damaging fluorinated refrigerant gases instead of natural refrigerants. Previously M. Mate had been a

key campaigner for Greenfreeze, the world's first and now mainstreamed natural refrigerant refrigerator. He was a key person promoting the 93-94 Ecofrig venture between India, Germany and Switzerland accelerating the uptake of natural refrigerants in refrigerators with Godrej as a pioneering firm in the field. Both Mr. Shende and Mr. Mate are on the Fairconditioning's Advisory Board.

The choice to establish Fairconditioning in India was an obvious one for Noé21 and cBalance. The partnership seeks to accomplish all of the goals and objectives of the different component parts of the programme. India, as a developing market economy in a very hot climate zone, makes it a perfect incubator for Fairconditioning. Successful implementation of Fairconditioning in India will also set up a sustainable model for intervention in other countries with similar climate challenges and climate conditions.

Today, all ACs in India run on 'F-gases' (HFC, HCFC). 2.5 million of these GHG emitting ACs are sold in India every year.

I.1 - Building Energy Performance in India - Where it is and Where it needs to go

The cooling and refrigeration needs in India are by far the most significant source of energy demand throughout the country, and these needs and demands are rising at the same rapid pace as economic development. Here lies a powerful 'beginning-of-pipe' opportunity to cool building interiors more efficiently.

Source: http://high-performancebuildings.org/index.php

The 'Energy Conservation Building Code (ECBC)' and the 'Bureau of Energy Efficiency (BEE) Commercial Building Energy Performance Benchmarking Programme' (Star Rating) have established the concept of "Benchmark Energy Performance Index" values (kWh/m^2/year) for various building usages and climatic conditions. However, these concepts have not yet transformed the Indian building energy consumption scenario due to a lack of awareness and insufficient emphasis on increasing uptake of these codes. The lack of awareness of the ECBC, launched in May 2007, is reflected in low rates of compliance throughout India; the annual rate of compliance with ECBC in business-as-usual scenarios is very low (less than 1%)[1]. While projects have been devised to improve Energy-Efficiency in India, it is clear that currently prevailing strategies are not able to overcome some key hurdles; the UNDP Global Environment Facility (GEF) Project forecasts that the rate of compliance with ECBC would be at 10% from 2011 to 2013, 20% in 2014, 35% in 2015, 50% in 2016, 65% in 2017 and 80% from 2018 until 2025. These forecasts are ambitious, but there is no corroborating data to support the view that they will actually be met under current conditions. In the view of Noé21 only a knowledge-centric, outreach campaign based on academic input and sound scientific analysis, aiming at sensitizing and empowering key stakeholders in the indoor cooling sector will increase the chances of reducing the average energy performance index (EPI) of buildings, old and new.

The "Building Energy Performance Benchmarking Programme" assigns a rating of 1 to 5 Stars for the EPI ranging from 100 to 200 in the most challenging climatic zones (warm and humid). The EPI for commercial buildings in India is currently 200 – 400; that of developed nations (for heating indoors) is on average 140. It is widely recognized by experts that the EPI of conventional buildings is 50% higher than the EPI of energy-efficient buildings. Furthermore, the UNDP GEF Project states that all commercial buildings in India are expected to meet the specific energy consumption (SEC) of 180 kWh/m2/year in the near future. This sets a remarkably challenging target for India and similar developing economies to reduce energy consumption in existing buildings by 50% through a combination of behavioural, demand-side management (DSM) and technology overhaul strategies.

Noé21 and cBalance are engaging with a wide range of stakeholders including the Indian Green Building Council and the Green Buildings Rating System India (GRIHA). We are creating alliances with the green building movement to coordinate our actions and reinforce our impact while avoiding duplication of effort. These actions will be built up through knowledge-exchange events, a series of webinars, and a regular exchange between heating, ventilation and air conditioning (HVAC) consultants with a storyboard of successes in both India and abroad.

1 United Nations Development Programme, India, Global Environment Facility, Project Document, Energy Efficiency Improvements in Commercial Buildings (2010-2012)

II. Framing the problem

Reducing GHG emissions is both an environmental issue and a human developmental issue.

II. 1 - The Environmental Challenge - when cooling interiors means global warming

The UN Office for the Coordination of Humanitarian Affairs (OCHA) reports that in the last decade 2.4 billion people were affected by climate-related disasters compared to 1.7 billion in the previous decade. Destructive sudden heavy rains, intense tropical storms, and droughts leading to reduced crop yields are likely to increase, as will the vulnerability of local communities in the absence of strong concerted action locally and globally.

Creating an energy-efficient future is a shared responsibility between developing nations and the first generation of industrialised nations who have created the overwhelming majority of the present atmospheric GHG concentrations that historically reached 400 ppm this year.

Power generation in India accounts for approximately 38% of GHG emissions in the country. While thermal power represents approximately 65% of the installed power generation capacity, coal contributes to the actual fuel mix at the level of 90%[2]. Coal-fired power plants are the biggest GHG emitters – spewing out 647 million tonnes of CO_2 per year[1], with coal combustion as a whole from India representing approximately 8 % of global coal-related GHG emissions in 2011[3].

Total energy generation capacity in India since independence is now forecast to double every 10 years. This growth will create the need to build 150 standard-sized (245MW) coal-fired power plants each year. As the Indian middle class grows and aspires to improve living conditions, the demand for ACs is developing exponentially. Of all the lifestyle enhancements sought by this growing middle class, reducing interior temperatures with air conditioning is amongst the first steps on the consumption ladder being taken by households with increasing disposable income. The annual AC sales growth rate is a staggering 12%, far exceeding India's GDP at 8%. Within 20 years (from 2010 to 2030), this will lead to a 10-fold increase in AC sales.

Energy production in India is highly carbon-intensive and will increasingly impinge upon India's climate change mitigation goals under the UNFCCC decided during the COP-15 in December 2009 i.e. 20–25% reduction in GHG intensity of its GDP by 2020 from 2005 levels in terms of GHG emissions per INR of India's GDP.

Energy Scarcity

Thus, increasing energy demand for thermal comfort will have multiple consequences on an unprecedented scale on global climate change as well as on local pollution through thermal power generation. **People living in rural areas where coal-fired power plants have been built suffer from severe local pollution (gaseous and solid waste) and do not see the energy reaching their homes and communities more hours per day than they did before. This is because power is channelled in priority towards urban areas and industry. Energy access especially in rural areas as well as the overall energy security of India are directly threatened by inefficient energy use uselessly driving demand upwards, most notably by the cooling sector.**

2 Source: India: Greenhouse Gas Emissions 2007, INCCA Indian Network for Climate Change Assessment, Ministry of Environment and Forests Government of India, May 2010

3 Source: Ministry of Power, 2009-2010 statistics, http://www.powermin.nic.in/JSP_SERVLETS/internal.jsp

Coal-fired power plants are the biggest GHG emitters. Growth in India will create the need to build 150 standard-sized coal-fired power plants each year.

II. 2 - The Sustainable Human Development Challenge

India faces an energy shortage of 8.7% and a peak shortage of 9%[2] as the number of households connected to the grid increases and household energy use soars. Per-capita energy consumption in India has increased from 1471 kWh/year in 1980-81 to 4816 kWh/year in 2010-2011[4]. A portion of this increase actually brings no added comfort or service but is lost in the form of pure waste by poorly designed buildings, inefficient appliances and inappropriate behaviour by end users. The increasing energy demand from air conditioning will exacerbate the already broadening gap between the energy consumed by the more privileged economic strata of India and the sections of society whose quality of life is governed by below-poverty-line or near poverty-line household incomes. As a consequence, a large part of India's 'Carbon Space' is used by a relatively small portion of society. This lack of access to electricity especially affects women. In Himachal Pradesh for example, women spend on average, each month, 40 hours collecting fuel wood. This breaks down to 15 round trips, each of 2.7 hours, and a monthly distance walked of some 30 km[5]. Scarcity in LPG and kerosene goes hand in hand with scarcity in access to electricity. Both have direct negative effects on disposable time to study and this is felt especially by women who perform the vast majority of household chores.

The phenomenon referred to as 'Hiding Behind the Poor' has led to a situation whereby the carbon footprint of the small wealthy class (1% of population) is camouflaged by the 823 million poor people who keep overall per capita emissions below 2 tonnes of CO_2 per annum. This fact co-exists with the reality that the carbon footprint of the 4 highest income classes earning more than INR 8,000 per month (150 million people), already exceeds sustainable levels[6]. **Disparity in energy access is a direct contributor to disparity in sustainable human development opportunities available to the poor versus the rich.** The severity of this issue has been emphasised by UN Secretary General, Ban Ki Moon saying, «Universal energy access is a key priority on the global development agenda. It is a foundation for all the Millennium Development Goals (MDGs)». Without access to energy, billions of women, men and children are denied the opportunity to improve their lives - to stay fed and healthy, earn a living and receive education. With access to energy, whole communities have the power to challenge their poverty, helping them to attain the MDGs in the process. This global need has now been formalised by the United Nations Advisory Group on Energy and Climate, which has called for a major UN initiative to achieve universal access to modern energy services by 2030 through the collaboration of 20 UN agencies (UN-Energy), which will lead the effort[7].

Finally, the indirect economic impacts of increasing energy use by net energy importing countries such as India, compound the direct impacts of skewed energy distribution amongst diverse populations and communities. In 2009-10, India imported approximately 15% of its annual coal requirement and more than 70% of its crude oil requirement[2]. The country is encountering a continually rising fuel import bill and a resultant undermining of its national energy security. This excessive import dependence has led to rapidly rising fuel prices, accompanying inflation, a loss of foreign reserves, and a consequent diminishing value of its national currency versus the USD. The trickle down impact of these interrelated

4 Source: Energy Statistics 2012 Central Statistics Office, Ministry Of Statistics And Programme Implementation, Govt. of India, Table 6.2

5 Source : "The Energy Poverty and Gender Nexus in Himachal Pradesh, India: The Impact of Clean Fuel Access Policy on Women's Empowerment", Professor Jyoti K Parikh and Saudamini Sharma from Integrated Research and Action for Development (IRADe), 2005

6 Source: Hiding behind the poor: A report by Greenpeace on Climate injustice

7 http://www.unfoundation.org/what-we-do/issues/energy-and-climate/clean-energy-development.html

phenomena is felt directly by the poorest households and results in a trimming of long-term private and public expenditure on sustainability initiatives, renewable energy procurement, alternative fuels, etc. as increasingly the economic resources are required for maintenance of development-as-usual. This escalating positive-feedback loop undermines the sustainability aspirations of developing economies.

Fairconditioning is defined by its visible focus on efforts to redistribute the energy use 'pie' by moving away from thermal comfort related energy use (an urban and privileged income class use of energy), to allow the limited national energy reserves and expensive imported energy to be used for serving more fundamental objectives that directly impact the achievement of the UN MDGs within India.

II. 3 - The Energy-Efficiency Challenge

Energy intensity of the GDP of developing countries is, in general, much higher than that of developed nations. India's Energy Intensity in 2008-2009 was 0.55 kg oil equivalent (OE)/$GDP, while the world average and that of the United States were 0.30 and 0.20, respectively[8]. As a consequence, there is a large disparity in the efficiency of use of direct and indirect energy resources. The only sustainable way of ensuring holistic growth (economic, ecological and social) in developing economies is by decoupling GDP growth and Energy Demand through the reduction of Energy Intensity per unit of GDP in their economies. Also, the challenge of replacing fossil fuel sources of energy by renewables at the current rate of consumption growth will represent a heavy burden on India. A readily available win-win solution (for people, for the country and for the environment) is to increase Energy Efficiency in indoor cooling. Poorly conceived buildings and homes lead to increased mechanical cooling and useless energy bills as well as an environmental cost that becomes impossible to pay back. However, efficiency will not eliminate the demand for energy. Efficiency will decrease the amount of new renewable energy sources needed to reach the strategic end-goal of 100% clean renewable energy sourcing. In the absence of efficiency, precious new renewable energy sources will be wasted on leaks, and generally on consumption that add no net value for end consumers.

Staggering energy costs, both in terms of detrimental environmental impact and negative economic consequences, can be avoided in the second generation of industrialised high-growth countries, among them Brazil, India, China, South Africa, and Mexico. These countries all have vast areas with hot and humid climates where thermal

8 Interim Report of the Expert Group on Low Carbon Strategies for Inclusive Growth, Planning Commission, Government of India, May 2011

An example not to follow

In the temperate climate areas of the industrialised nations in Europe, North America, Japan, and Korea, close to half of today's emissions of GHGs comes from heating buildings during the winter months. Today, these countries are using vast amounts of primary energy to attain indoor thermal comfort, only to compensate for poor planning, a disregard for the available knowledge on thermal insulation and passive heating techniques, and a poor choice of building materials. The post-war construction boom has left a legacy of costly, energy-inefficient buildings. If these countries had used the best available technologies and insulation know-how at the time of constructing their buildings (mainly 1960s – 1990s), the current situation regarding climate change and its resultant implications for both public and household finances would have been dramatically different. Initiator of Fairconditioning, Noé21 is working closely on this issue in Switzerland and is driving its programme in India from a vast wealth of experience with retrofitting ill-adapted building stock.

Currently, the EU Energy-Efficiency Directive is aiming to scale up the building renovation rate in Member States from a current average of 1% to more than 3% per year. These renovations will need to be deep renovations. Against a background of rising energy prices, looming CO_2 taxes on oil, and global warming, the insulation of the current building stock is not only a low hanging fruit but also a necessary and urgent step that needs to be taken.

Today, OECD countries are tackling the issue of retrofitting their building stocks. This can only be achieved with massive financial incentive mechanisms and hard-to-achieve political momentum. If the necessary political consensus is not achieved to start a deep retrofitting programme, OECD countries will continue to import fossil fuels at rising costs, and households and businesses will continue to overspend and over emit GHG gases by heating ill-adapted buildings. The cost of heating interiors, the cost to the climate (half the climate footprint in the OECD area), and the cost for the economy (upfront finance for deep renovation incentives) could have been reduced to a fraction of today's running (plus retrofitting) costs, had developers used the best available know-how and materials.

comfort relies principally on cooling interiors. The know-how and technology available today mean that delivering zero or near-zero energy buildings is feasible at low additional costs that are paid back by reduced energy bills. For existing buildings, modern retrofitting capabilities can also significantly reduce energy demand to achieve indoor thermal comfort. Although enhancing Energy Efficiency in the building sector seems to be an obvious move today, a wide gap remains to be filled between available expertise and on-the-ground building and retrofitting practices.

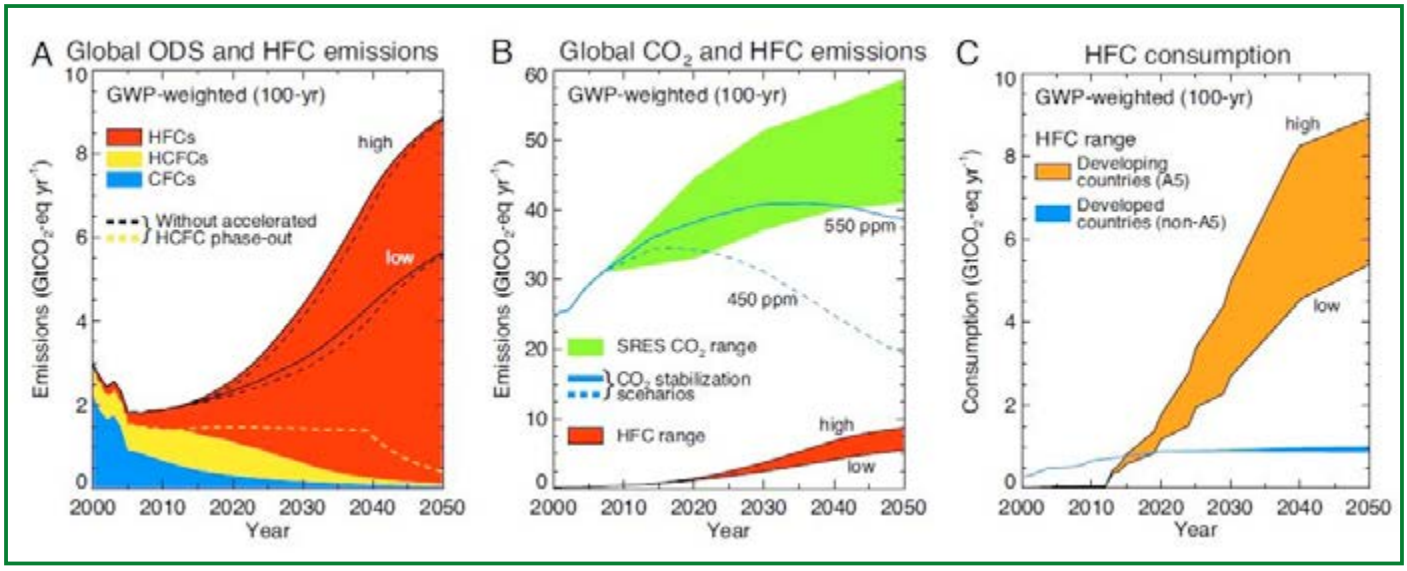
II. 4 - The High Global Warming Potential (GWP) Refrigerants Challenge

The use of f-gases worldwide is booming. The first two generations of f-gases (CFCs and HCFCs) were eliminated to protect the ozone layer under the Montreal Protocol (United Nations Convention for the Protection of the Ozone Layer). The third generation HFCs (safe for the ozone, but hazardous to the climate), are quickly being phased in. If nothing is done to reduce the spread of HFCs, this gas could account for 28 to 45% of all carbon equivalent emissions by 2050 (Figure 1), thereby impeding the current efforts to reduce other GHG emissions. In this period of technological lag, the current international negotiations (Montreal and Kyoto protocols) are not fostering the needed momentum for change. Civil society and development agencies can be instrumental in adding the necessary bottom-up impetus, know-how, and experience on the ground.

«The Ministry of Environment and Forests of India supports this project as it addresses two important objectives of the Indian Government: Reducing greenhouse gas emissions and increasing Energy Efficiency.»

Sushilkumar Shinde,
Ministry of Power, Government of India

Figure 1:
A: Worldwide emissions of ozone-depleting substances (ODS) and HFCs,
B: Global emissions of CO_2 and HFCs
C: HFC consumption for the period 2000-2050 - CFC data include all the main ODS in the Montreal Protocol except HCFCs. Emissions from different gas types are multiplied by their respective GWP to calculate emissions in $GtCO_2$/ year. (Velders et al., 2009).



III. Framing the Solution

III. 1 - New generation of energy-efficient natural gas refrigerants produced in India

GIZ, the German Development Agency financed and piloted a programme to assist GREE Electric Appliances of China and Godrej & Boyce Manufacturing of India to each convert an AC production line to manufacture air conditioning units equipped for the first time with natural refrigerants, namely propane. Propane

replaces the need for mega GHG refrigerants in this sector. Natural refrigerant (see 1.2) alternatives are readily available on the market. Within the European Union, air conditioning manufacturers have made investments for the past several years as consumer demand for natural gas appliances continues to grow. Today, AC manufacturers in high-growth countries are investing heavily in new production lines. Two options are open to them: HFC AC manufacturing plants, or natural refrigerant AC manufacturing plants. Producers have the choice of waiting to switch towards Natural Refrigerant ACs under the constraints of legislation or a binding UN Convention that will force the phase-out of HFCs or be pioneers in their field by opting for natural refrigerant AC production lines up front.

III. 2 - 2012/2013 'Campaign for Natural Refrigerants.' Pilot Phase for approaching an integrative cooling solution

The Pilot programme 'Campaign for Natural Refrigerants', undertaken by Noé21 and cBalance from June 2012 to June 2013 in Mumbai, was designed to foster a successful uptake of the new generation of Natural Refrigerant ACs and to contribute to making them the standard choice for cooling Indian interiors.

The Pilot programme catalysed bottom-up uptake of natural refrigerants in India amongst 4 clearly identified stakeholder groups:

- academia
- technical experts
- advocacy bodies
- cluster consumers.

The Pilot focussed on environmental and running costs impact awareness creation, knowledge transfer, and building reputation and business cases to support one key technological innovation – the use of natural refrigerant–based split-unit ACs.

The target audience was high-usage individual homes and cluster consumers in India. The Pilot served as a learning experience to test the efficacy of various strategic alternatives and to lay out the overall programme strategy for Fairconditioning Second Phase. The programme was deliberately limited in scope in order to test the validity of this new generation of refrigerants produced today by Godrej & Boyce Mgf of India.

The programme created innovative ways to help India leapfrog from HCFCs directly to energy-efficient natural refrigerants. It promoted bypassing the temporary use of alternative HFCs that are currently only serving the commercial interests of a few industrial manufacturers while ignoring the greater goal of economic and social prosperity and

environmental protection in India and worldwide. The programme secured the public support of several key actors in the field who became convinced of the positive impact of natural refrigerants on energy-efficient air conditioning.

The greatest impact of the Pilot programme on the ground has been two-fold:

1. To associate in the minds of Indian opinion makers and cluster consumers two previously separate issues: the potential for Energy Efficiency gains (+ GHG-emission reduction) and the choice amongst air conditioner types on sale.

2. To build knowledge capacity for Noé21 and cBalance to design a broader and deeper focus for the Second Phase of Fairconditioning from 2014 - 2017.

The Pilot programme provided unexpected conclusions that taught the team four useful lessons for 2014-2017 :

1. Representatives from technology and architecture institutes, developers, AC consultants for developers, hotel and bank chains and energy management companies have shown keen motivation to be part of this programme as much as they have been enthusiastic to discover new ways to save on their energy bills or those of their clients. The momentum is established; several stakeholders have become technology, academic or consumer Ambassadors (see chapter V, p. 22) for natural gas ACs.

2. One of the reactions to the new generation of Natural Refrigerant ACs by trend-setting professionals has been concern over safety issues. The Pilot team recognised the need to communicate efficiently and effectively with building professionals in order to make information on security testing and credentials readily accessible.

3. For cluster consumers and individual customers, the type of refrigerant gas an AC is equipped with is not a purchasing factor. What counts is upfront cost and overall running costs related to Energy Efficiency performances.

4. The potential to reduce energy demand according to the projections made by the Indian indoor cooling sector are significant, but yet untapped. This potential not only signifies the feasibility of a rapid market uptake for natural gas split unit ACs, but also encourages the development of beginning-of-pipe interventions such as the construction of energy-efficient building and retrofitting capabilities.

To expand the scope of its work, the Fairconditioning team will build on experience and lessons learned during the Pilot phase. The programme implementation from 2014-2017 includes several vehicles/interventions in addition to the promotion of Natural Refrigerant ACs. All these vehicles are designed to bridge the gap between current practices and the implementation of available technologies, and will be deployed amongst key stakeholders to incubate notions and practices of Energy Efficiency in the indoor cooling sector. The conclusions drawn from the Pilot programme are indicative of how cluster consumers and influential stakeholders perceive the issue of indoor cooling. Perceptual change precedes behavioural change. Fairconditioning encourages the purchase of energy-efficient ACs through the perception of overall costs including operating costs (see Faiconditioning newsletter N° 2). In addition to the choice of cooling technology (R-290 ACs or evaporative cooling in hot and dry climates), Fairconditioning has built upon the Pilot programme by creating additional chapters for student and professional continuing education.

The skills that were required to implement the Pilot phase are the same as those that will be needed for Fairconditioning : a proactive attitude to building lasting partnerships with key industry representatives and academics. The Fairconditioning staff in India and in Switzerland benefits from a well established network of professionals who are sharing their knowledge and expertise and cross-fertilising their networks to implement beginning-of-pipe solutions. The Fairconditioning team will draw upon social entrepreneurial skills based on social marketing through proximity, personal contacts and building sustainable, trusting relationships within an expanding stakeholder network. Flexibility and perseverance are key to incubating the relatively new idea of Energy Efficiency in indoor cooling within a community of stakeholders. Given the motivation of the Fairconditioning team and the receptivity of its partners, the scaling of the programme to 8 urban centres is moving ahead according to schedule.

III. 3 – Fairconditioning Phase 2: "Cooling India Efficiently and Sustainably" 2014 - 2017

Fairconditioning is now moving into its expanded implementation phase, launched in June 2014. This Second Phase identifies a new set of key stakeholders in India to further incubate Energy Efficiency in the way interiors are cooled.

Fairconditioning is a Building-Cooling Demand-Side-Management (DSM) related education, capacity building, and pilot implementation programme. It is designed as a evidence-based policy support programme that seeks to create a critical mass of evidence for programmes that could be scaled-up across India and other tropical climates to achieve behaviour change amongst occupants of conditioned indoor spaces, reduce building heat loads (cooling demands), reduce energy and GHG intensity of artificial cooling systems. The goal is to determine the types of programmes, and their essential features, that can successfully avoid power generation, to improve energy access, and to lower GHG emissions.

Fairconditioning has developed a bottom-up approach using Vehicles/Intervention Groups as shown below:

III. 3.1 – The Programme Structure

Fairconditioning articulates a Three-iii Approach for transforming the cooling of interiors in India:

- **I**nfluencing consumer behaviour
- **I**mproving efficiency
- **I**ntegrating available technologies

The Programme Intervention Matrix below presents the 'Projects' that emerge as a product of engagement between a 'Vehicle' - i.e. a Intervention Group and a given 'Approach'. 'Intervention Groups are stakeholders in the Building Industry (directly or indirectly involved) that exert an influence over the social and technical perception of, and preferences for, buildings, architecture, and cooling technologies. Through this they influence the consumption patterns of buyers, renters, and leasers of built spaces and cooling technologies.

This process of mapping intersections has thus led to the creation of 5 projects which are described below. The 'Vehicles' are essentially enabling groups of actors which the program engages with to achieve the declared Project objectives. The creation and activation of these 'Vehicles' is a exercise in outreach and network building which is described below. While not 'Projects' in themselves, the creation of these 'Vehicles' can be seen as a lasting legacy of the Fairconditioning Program which can be harnessed to promote the objectives of future programmes designed to address similar or related issues concerning India's cooling sector.

The 5 projects collectively address 2 widely practiced forms of interventions by science in society:

1. "beginning-of-pipe" interventions targeting the reduction of cooling demands in the 8 urban centres, and
2. "end-of-pipe" interventions addressing the must-have or residual cooling demands that persist despite other reduction measures; these need to be implemented with the most energy efficient technologies available to reduce GHG emissions and provide significant running cost savings.

APPROACHES	INTERVENTION GROUPS			
	Decision Makers	**Influencers**	**Educators**	**Practitioners**
Influencing Behaviour	Corporate Thermal Comfort Policies Campaign	Corporate Thermal Comfort Policies Campaign	Upby2 Campaign	
Improving Efficiency	Energy Modelling & Advisory Project		Academic Curricula Integration Project	Energy Modelling & Advisory Project
Integrating Technologies	Tech Adoption Project	Tech Adoption Project	Academic Curricula Integration Project	Tech Adoption Project
Vehicles	**Voluntary Adoption Vehicle**	**Consumer & Industry Ambassador Vehicle**	**Academic Ambassador Vehicle**	**Technical Ambassador Vehicle**

Table 1 : Intervention Matrix

III. 3.2 – Fairconditioning Vehicles

The **Voluntary Adoption Vehicle** seeks to create inspirational commercial examples for sustainable efficient cooling of India's interior by recruiting iconic first-movers that peers aspire to emulate. It engages the more visible and existing best-practice leaders (external to the Fairconditioning Programme's domain of influence) along with newly activated Sustainable Building Design Integrators and Cooling Technology Adopters amongst banks, hotels, and builder/developers and the IT industry to share and showcase their successes in the form of Road-Show events, industry specific seminars etc. to continue expanding the network of 'converted' voluntary technology adopters. The goal of the vehicle is to expedite the recruitment of low-hanging fruit enterprises that have demonstrable sustainability implementation and communication activity integrated into their business processes but haven't magnified their sustainability successes to encompass efficient and sustainable cooling for their building stock.

The **Consumer & Industry Ambassador Vehicle** is comprised of industry associations, umbrella bodies of commercial sectors, and civil society organizations that influence public opinion on environmental and climate change issues. This vehicle is activated by enrolling and empowering them to disseminate objective information about the environmental and cost benefits that individual or commercial consumers can harness if they decide to choose efficiency first. Their user and membership networks are also activated for the purpose of outreach amongst commercial entities that are ostensibly major cluster consumers of Air-conditioning in the Hospitality, IT/BPO, Real Estate, and Banking sectors of the Indian economy.

The **Academic Ambassador Vehicle**
The vehicle performs the dual functions of support-group to aid curricula integration amongst academic participants in Architectural Training-of-Trainer Workshops as well as perform the role of a magnet to attract and recruit academic institutions into the process of student certification and curricula enhancement. It comprises existing and newly activated academicians that can serve as exemplars of enhanced architectural and HVAC engineering pedagogy that deeply integrates sustainability and efficiency into their respective curricula across a spectrum of technical and non-technical courses. Their experiences and expertise are harnessed through the creation of city-level support groups which greatly lubricates the process of replicating their successes in institutions whose faculty has acquired intensive training in and benefited from the ToT workshops. Furthermore, this vehicle's continually magnifying roster of success stories assists in recruitment of new institutions that have not yet been engaged by the Programme and catalyses their interest in considering curricula enhancement. As the program progresses towards formal advocacy at its latter stages, this vehicle plays a pivotal role in forming a persuasive body of actors that serve as successful demonstrations of the possibilities and benefits of integrating efficiency and sustainability into engineering and architecture curricula as a default feature across all Indian universities.

The **Technology Ambassador Vehicle** empowers and enrols technical experts and institutions with a high degree of expertise in the realms of Energy Efficiency, HVAC refrigeration technology, and environmental impact of space cooling technologies. The membership of this vehicle is continually magnified through the inclusion of trained Architects and HVAC engineers emerging from the Building Energy Modelling Advisory Project. Together with existing experts, these newly created Technology Ambassadors aim to catalyse interest and enhance confidence among the technical decision makers in commercial and industrial enterprises related to Building Design and HVAC systems. Furthermore, they will be empaneled as vetted Architectural and HVAC Engineering service providers that will form the service provider network to facilitate beginning-of-pipe approaches for enhancing building Energy Efficiency through the efforts of the Technology Adoption Program.

Fairconditioning Business Case Competition Jury at IIM, Ahmedabad, March 9 2013

For all the programmes listed above, specific workshops are organised as follows:

For the Energy Modelling & Advisory Programme:

i) 3-day workshops held twice a year in Tier 1 (Mumbai, Delhi, Chennai, Kolkata) and Tier 2 (Ahmedabad, Hyderabad, Pune, Bengalore) cities for 3 years will impart training to empanelled Architects and HVAC Consultants. The workshops will focus on highly sophisticated building energy modelling (for Architects) and heat-load and sustainable cooling technology design softwares which will be used by the architects the trained professionals to provide low-cost building design related Energy Efficiency advisory services to SMEs in the 8 cities

ii) Roadshows and Roundtable Discussion to showcase services and benefits available to Project beneficiaries will be conducted as a coordinated activity with the Technology Adoption Program. One such event will be held annually in each of the 8 cities. Commercial enterprises will sought to be influenced through case-studies distilled from experiences of existing program partners to underscore measurable and verifiable benefits of building design efficiency and sustainable cooling technologies. The goal will be to recruit new beneficiaries through these industry interactions that will be mediated by partner Industry Associations and Umbrella Groups that shape opinions within sectors.

For the Technology Adoption Programme:

Roundtable held once a year in Tier 1 (Mumbai, Delhi, Chennai, Kolkata) and Tier 2 (Ahmedabad, Hyderabad, Pune, Bangalore) cities for 3 years establish engagement between all relevant stakeholders: senior management and engineering executives from cluster consumer companies, alternative cooling technology experts and practising HVAC consultants and architects. These roundtables will delve into the relevant business cases, feasibility studies for each commercial sector, and address specific technical issues leading to knowledge transfer and information dissemination which is imperative to encourage cluster consumers to adopt efficient cooling technologies.

« What you are proposing is extremely strategic. Air conditioners in India are probably the highest priority sector worthy of support. »

Brent Hoare
Executive Director Green Cooling Association, Katoomba (AUS)

For the Academic Curricula Integration Programme:

For Architecture Academia: an eminent Architecture College in each city (renowned for its progressive teaching methods and vibrant faculty) will be selected and approached to make it a Project HUB College. A steering committee comprising of the project team and professors and department heads from the HUB college aids in localization and customization of the training content to align it with the prescribed curricula by the regional university to which colleges are affiliated. 4 other colleges in each city will be approached and MoUs will be signed with management to affirm their intent to support curricula upgrading through efforts by trained professors post conclusion of workshops. All 5 colleges will identify a blend of the most suited professors spanning the educational spectrum of design related (3 professors) and technical courses (3 professors) who will attend a 3-day Training-Of-Trainer Workshop. A pre-requisite for attending the workshop will be successful completion of an online course (a MOOC) created by Fairconditioning.

This 9-module MOOC provides a rigorous grounding in scientific and technical concepts related to Building Physics, Passive Design and Sustainable Cooling Technologies that will inform the subsequent ToT workshop. The ToT workshop will therefore be a intensely focussed exercise in imparting pedagogy related training related to technical and design concepts imbibed by trainees through the MOOC.

The ToT project effort will encompass devising and compiling of teaching aids (physical models, software tools, testing and evaluation aids) and conduct training sessions that empower, guide, and provide actionable-knowledge to teachers who can then seamlessly embed syllabus content related to efficient and sustainable cooling strategies (design and technology) across courses covering climatology, building materials, building technologies, structural design, history and theory of design, architectural design. and building science and services. A vital feature of the ToT project is the establishment of

city-level support groups comprising resource persons who can serve as a troubleshooting platform for professors in their efforts to integrate augmented syllabi in college curricula.
Furthermore, teachers will have perennial access to physical teaching aids post successful completion of workshops. This is anticipated to take the shape of a laboratory situated in a specific college campus or be conceived as a library wherein colleges can borrow aids for a finite duration during the academic year.

Over 3 years, **24 ToT workshops will be conducted** which will catalyse curricula integration **in 120 colleges across India.**

For Engineering Academia: The engineering academic intervention is distinguished from the architectural intervention is one primary manner. Instead of training trainers (professors), this program directly trains mechanical and civil engineering students through 5-day certification programs.
A similar HUB and partner college approach is followed, but the primary stakeholders in this process are students and not professors. The rationale for adopting this distinctly different approach is that Mechanical and Civil Engineering students are presented with multiple professional options beyond HVAC Engineering or Building Construction. Automotive Engineering, Robotics, Industrial Engineering, Infrastructure Construction etc. all compete with HVAC Engineering as career paths selected by graduates. Thus, spreading the specific knowledge related to Building Physics, Envelope Efficiency and Sustainable Cooling Technologies amongst the general student population was not deemed to be a tenable strategy.

Registration for these training courses are therefore open to 3rd year engineering students across a city and only students who are largely certain about pursuing a career in HVAC Engineering or Building Construction Technologies are encouraged to participate.
A vital feature of the certification workshops is the rigorous hands-on training imparted to students to enable mastery of heat-load calculation and sustainable HVAC system modelling softwares. Post successful completion of evaluations and procurement of a certificate, students and their colleges are given free 1-year licenses for using these tools developed by the Indian Society of Heating Refrigeration and Air Conditioning Engineers (ISHRAE). Over 3 years, **24 certification workshops will be conducted for 1440 students from 72 colleges across India.** Upon completion of the programme, a comprehensive annual workshop with the academic and State educational authorities will be conducted to explore mechanisms for permanently establishing Fairconditioning certificate programmes at the State Level in at least 4 Indian States and absorbing all relevant academic content emerging as an output of the programme into the conventional mainstream architectural and mechanical engineering curricula in these States.

For the Corporate Thermal Comfort Campaigns:

Workshops with cluster consumer corporate entities in each of the 8 cities will be held at the beginning of the programme to stimulate the interest and impart vital information related to the benefits of climate-appropriate thermostat settings and dress code policies to achieve significant energy savings from cooling at virtually zero cost to corporate operational expenses. These workshops will formally kick off the corporate campaigns in the cities.

All workshop attendees already have expertise in their field and will be encouraged to capitalise on their experience. These trained Ambassadors will constitute one of the lasting legacies of Fairconditioning in the form of key stakeholders apt to disseminate Energy Efficiency in the Indian urban culture. This bottom-up knowledge-centric outreach and education campaign aimed at stimulating action amongst stakeholders is typical of a social entrepreneurial approach.

III. 3.3 - Resilience in Urban Environments

Societies can respond to climate change by embracing two options: adaptation to climate change impacts and mitigation (reduction of GHG emissions). These are not mutually exclusive and are often interlinked thus providing co-benefits. The world community is already committed to additional warming of 0.6 to 1.5°c by 2100 due to the GHG already emitted (committed climate change)[9] . Aside from the possibility of controversial geo-engineering measures, we cannot mitigate that change and therefore must adapt to at least that amount of climate change. Regardless of the magnitude of GHG mitigation efforts undertaken,

9 1.50C likely range of surface warming by 2100 relative to 1850-1900, IPCC WGI AR5 (Climate Change 2013: The Physical Science Basis, Summary for Policy Makers), 0.60C based on projected global average surface warming at the end of the 21st century under constant year 2000 concentration, Climate Change 2007: Synthesis Report, IPCC Fourth Assessment Report (AR4)

adaptation measures will be required at regional and local levels. While vital and beneficial, these efforts will be confronted with financial, technological, cognitive, behavioural, political, social, institutional and cultural constraints[10] .

The IPCC's AR4 clearly defines key adaptation options for various sectors of global human activities. For the energy sector - Energy Efficiency, the use of renewable sources, and reduced dependence on single sources of energy are the cornerstones of adaptation options. Concerning the access to viable alternatives, the following key constraints and opportunities to implementation are mentioned: financial and technological barriers, acceptance of new technologies, stimulation of new technologies, and the use of local resources.

While the mitigation benefits of Fairconditioning have been elaborated upon in earlier sections, the adaptation aspects of the proposed interventions are underscored here. **Fairconditioning also directly addresses some of the key Energy-Efficiency-related adaptations suggested by IPCC reports on the subject.** Further, it also recognizes and builds in appropriate responses to widely recognised constraints that adaptation efforts are likely to face and have faced in the past in developing economies - namely access to viable alternatives, financial barriers and use of local resources.
The following aspects that are embedded into Fairconditioning's intervention approach serve as the key 'resilience' pillars in the programme's architecture:

- **Building Energy Modelling Advisory services:** This initiative seeks to serve as a demonstration model for enabling commercial buildings in India owned by SMEs to harness the potential for improving building envelope efficiency, in new buildings as well as in the case of building retrofitting. The advisory service train architects and engineers who will influence SME management to choose building designs and retrofits that are conceived to combat the impact of rising surface temperatures during the coming decades . Since passive design features often are insufficient to reach indoor thermal comfort in a business environment, residual cooling demands are met using only highly efficient mechanical thermal comfort systems relying upon natural refrigerants or evaporative cooling where feasible. Thus, dependence on fossil energy is also reduced and adds to the adaptive capabilities of buildings. This advisory service is a cost effective means to inspire SME procurement and management personnel to make sound environmental and economic decisions based on solid evidence for savings. A ripple effect is expected for non-participating SMEs.

- **Voluntary adoption programmes:** Demonstration of viable financial mechanisms for achieving transition to adaptive technologies (energy efficient natural refrigerant cooling options) is a pivotal component of Fairconditioning. Demonstration of attractive return on investment through pilot-scale installation and performance monitoring as well as promotion of Energy Service Company-styled (Esco[11]) business models comprise this programme. By justifying the higher initial investment in technologies or eliminating the issue entirely through third-party investments, Voluntary adoption programmes seek to address the economic hurdle to adaptation approaches highlighted by IPCC Assessment Reports of the past.

- **Behavioural change campaigns:** Addressing adjustment to higher indoor temperatures through appropriate thermostat settings in commercial establishments as well as re-defining corporate dress codes serve as approaches to build in adaptive capabilities amongst urban citizens who will be required to adapt to higher surface temperatures outdoors compounded by reduced energy access required for powering thermal comfort appliances for indoor cooling.

- **Energy Conservation Building Code uptake:** This aspect of Fairconditioning addresses the need for climate change adaptive thinking, especially building Energy Efficiency, in the next generation of architects and HVAC engineers in developing countries to diminish barriers to implementation of climate change adaptation measures in building design, construction and operation.

10 Climate Change 2007: Synthesis Report, IPCC Fourth Assessment Report (AR4)

11 Definition by the US National Association of Energy Service Companies www.naesco.org/resources/esco.htm

- **Interweaving of urban resilience to depleting access to fossil fuels:**
  The phenomenon of peak oil, is an equally important factor that will directly define the resilience of urban environments in the near future. The consequent rising fuel and energy prices could directly influence the ability of economies to spend on long-term sustainable development and climate change mitigation measures. Decoupling cities from oil dependence is therefore essential to instil equilibrium and deeply embed economic, social and environmental resilience. Fairconditioning, through the above-described approaches, thoughtfully and deliberately builds a degree of fossil-fuel independence and resilience into local commercial activities and residential environments. Finally, Fairconditioning facilitates trickling upwards of the learning in resilience into urban planning and policy through field demonstration and validation achieved by means of pilot installations, knowledge transfer, and capacity-building programmes.

III. 3.4 - Detailed Project dDescriptions

Please note : from this point on to the end of section III, each section corresponds to the budget at the end of this document, in the same order.

III.3.4.1 - «Influencing Behaviour» Projects

This approach involves the influencing of behaviour within commercial establishments, corporate offices, and individual households. It relies upon non-technical options that are either low-cost or no cost (depending on the mechanisms adopted) and pivot around energy consumption habits. Before any investments are made in technical solutions requiring expenditures such as building thermal refurbishments or change in cooling devices such as ACs or evaporative cooling installations, programmes aiming at behaviour change are by far the most cost effective and the fastest to deploy. Fairconditioning is implementing two specific campaigns devised to influence energy consumption behaviour: thermostat setting modification and corporate dress code policies.

'Upby2' Campaign aims to influence academic establishments (students, teachers) and through them, commercial establishments and SMEs in major cities. These campaigns, created and piloted in Indian cities by one of Fairconditioning's partners, 'The no2co2 Environmental Project' creates social incentives for organising young adults in educational institutions to persuade local commercial establishments (cafes, restaurants, retail stores, cinema halls, etc.) to set their AC thermostat at a climate appropriate setting, typically Up by 2°C (e.g. in India, this temperature ranges from 24°C to 26°C). These campaigns parallel similar initiatives being implemented in Japan (Super Cool Biz campaign)[12] and the United Nation's 'Cool UN ' campaign[13]. Japan's climate is comparable to India's, but Japan started in 2005 to target excess GHG emissions during summer months due to ACs being set at very low thermostat temperatures. Japan's summer Energy-Efficiency policy was again boosted by closing down all of its nuclear power plants after the Fukushima catastrophe in 2011. This has made Japan the world's best example for Energy Efficiency in hot climates.

These 'Upby2' actions are quantifiable in terms of energy conservation, cost savings, and carbon footprint reduction achieved. A pre-established social carbon credit system for assigning points to 'Upby2' actors and a random-sampling based auditing mechanism are part of this campaign being run at virtually no cost.

Corporate Thermal Comfort Policies Campaign works directly with large corporations and industry associations as well as policy advocacy bodies to establish AC thermostat and associated workplace dress code policies to enable corporate offices in India to operate at 28°C without supplementary comfort issues. Experience from Super Cool Biz in Japan shows that companies having set their air conditioners at higher temperatures will promote loose fitting fashion, antiperspirant makeup and odour-fighting laundry detergents adapted to help keep women cool and stylish during the summer. The campaign also encourages men to forgo ties in favour of casual outfits so they can feel comfortable at the office, as well as in public and commercial facilities.

III.3.4.2 - «Improving Efficiency» Projetcs

Energy Modelling & Advisory programme:
This is a twin-purposed capacity building and eco-system building project. The capacity building

12 http://en.wikipedia.org/wiki/Cool_Biz_campaign
13 http://www.greeningtheblue.org/our-approach/reducing-our-impacts/buildings

component of the project seeks to provide training and resource support to architects and engineers to enable them to offer efficiency-related design services to the building industry. Through their professional practice of offering active and passive design solutions, these professionals will play a pivotal role in reducing the principal energy load in buildings: Artificial Cooling.

Most Architecture and Engineering practices today continue to create structures that are inefficient, dismally accelerating carbon emissions and energy demand at a global scale. Architects today have a remarkably low ability to perform quantitative energy analyses of the buildings they design and their prescribed cooling strategies, that are energy intensive HVAC designs.

Correspondingly, HVAC engineers are insufficiently sensitized towards the imperative and expeditious need for their industry to depart from the trajectory of GHG emissions intensive and HCFC/HFC refrigerant based technologies. They have consequently not made efforts to build technical capacity within their organizations to integrate sustainable cooling technologies as part of their spectrum of engineering design and advisory services.

The project addresses this systemic knowledge and skills lacunae amongst practicing architects and HVAC consulting companies through conducing rigorous training programmes which integrate energy efficiency within building design process for architects and engineers. The workshops include modelling software training, import/export with other softwares, understanding analysis and application of analyses results. Architects learn how environmental factors affect a building's performance, master the use quantified data to design sustainable buildings, and pathways to incorporate energy efficiency at every level of the design process.

HVAC engineers learn to predict the thermal behaviour of buildings prior to their construction and propose better suited designs. They will also simulate the costs of energy in existing buildings in their current conditions, thus enabling them to choose the best retrofitting measures.

A direct benefit of the workshops for the architects will be highly subsidized software licences for basic modules of energy modelling softwares that will be made available to all participants. Additionally, two free premium licenses for sophisticated softwares (include all modules) will be made available to the most meritorious and motivated participants as determined through participant evaluation tests, quizzes and demonstrated enthusiasm for acquiring these skills.

The eco-system building component of the project weaves the architects and HVAC professionals graduating from the training workshops, along with already qualified HVAC professionals and architects with established credentials as practitioners of energy efficient building and sustainable cooling technology design, into a vetted panel of service providers. Through Roundtables and other outreach efforts, their status trained professionals is made visible to companies from the commercial sectors engaged by the Technology Adoption Program. The trained professionals will also absorb qualified and motivated interns emerging from student certification workshops and collectively make low-cost energy modelling services available to SMEs (provision in the budget is for 160 projects). SME managers often associate Energy Efficiency only with investment intensive measures, not paying attention to a rapid return on investment. This Advisory Service initiative uses open-source or proprietary building energy modelling software that will develop building Energy Efficiency enhancement roadmaps for SME-owned buildings. The result will be the development of an implementable strategy achieved through a combination of improved building operational techniques, and heat-gain reduction options including retrofitting with energy-efficient thermal comfort technology and know-how. SMEs are specifically targeted because their energy costs considerably reduce their profitability. Unlike large corporations, SMEs do not receive subsidies and other forms of support. Further, SMEs do not have the in-house capacities and know-how to efficiently manage their energy consumption. They need external support, similar to the support offered by Regional Energy Efficiency centres, but in only 3 locations in India. The goal of this programme is to vastly increase building retrofits such as shading devices for windows, outer wall insulation and assisted ventilation.

« It's wonderful that you want to do this campaign! »

Janos Mate,
Ozone policy consultant,
Greenpeace International

This programme will also accelerate the uptake of best-in-class energy-efficient ACs and where applicable, evaporative cooling devices will also benefit from this programme in hot and dry climates and hot and humid climates.

While economic support will only be provided to SMEs to reduce adoption barriers, the engagement will also seek to include aligned large commercial building developers / corporations in the 8 selected cities. Prior work in this field of building energy modelling knowledge-sharing and capacity-building have led to a wide spectrum of software tools, technical guides etc. disseminated through workshops under various programmes commissioned by the BEE.

Fairconditioning's efforts under the design advisory programme will build upon previous efforts, utilize their established networks with design experts and consultants as well as directly use training materials already developed to avoid resource development and deployment inefficiency.

Academic Curricula integration programme:

Every year students acquire diplomas after studying mainstream architecture and engineering curricula taught in universities. These courses are generally devoid of content related to Green Building design principles and to the Energy Conservation Building Code. As long as this situation is left unchanged developers will be constructing buildings that are unfit for the prevailing Indian climate because they will entirely depend on air conditioning to reach indoor thermal comfort. From Noé21's experience in Europe, thermal refurbishing of buildings has a very long payback period, making these retrofits most unlikely.

Academic Curricula Integration Project addresses the imperative need to sensitize the academic fraternity that shapes the attitude of architects and engineers that will design the 70% of the built space that still hasn't been built in India but will come into being by 2030. This program sensitizes and embeds commensurate skills to inform approaches towards building design and passive as well as active building cooling strategies. It sets the compass of the future of the construction industry towards deeply embedded energy-efficiency and sustainable cooling technologies. The project takes a evidence-based policy making approach through its endeavour of enhancing engineering and architecture curricula in universities in each of the selected intervention cities. Over 3 years, the project will work towards formal adoption of the transformed curricula at the University level and derive actionable intelligence from field experiences that can inform the process of scaling this approach through state and national Education Ministry level policy change.

The project works through two distinct and academically endorsed approaches - for Engineering and Architecture Colleges, respectively. For Architecture programs, it works be means of conducting Training-of-Trainer workshops for Professors and seeks to inform the entire 5-year educational curricula spanning architectural theory, design and technical subjects which. The project deliberately avoids creation of 'additive' curricula content (i.e. separate courses) for Architecture colleges and instead works in an 'integrative' manner. It thematically expands the breadth of knowledge imparted from the current two-dimensional focus of 'space' and 'structure' to a three-dimensional realm wherein 'sustainability' is legitimized and centralized as an equal third axis that shapes the architectural process of the students engaged by it.

For Engineering colleges, the project recognizes the competing academic interests of and professional avenues available to students of Mechanical Engineering colleges. Automotive Engineering, Industrial Engineering, and Robotics are other fields of professional interest that are reflected in the 5-year curricula with Buildings and HVAC related courses forming a modest fraction of the body of knowledge imparted. The project therefore conducts direct student-certification courses related to Sustainable Cooling Technologies for the specific students that are deeply interested in the subject and anticipate pursuing HVAC engineering as a profession.

While long-term application of this project can make energy efficient buildings and sustainable cooling technologies a default method of building habitats, the expected short term benefit of this project is also substantial. It will greatly augment India's capacity to implement the ECBC. The program will help spawn a generation of trained architecture and engineering graduates that will be inspired by, conversant with, and abidingly competent to adopt the BEE's ECBC in their professional pursuits.

The BEE's efforts towards simplifying ECBC code implementation through: i) staged or tier-based implementation approaches, ii) enhancing uptake

rates amongst new constructions through IT solutions for compliance checking, and iii) establishment of third-party assessment frameworks, have all led to an abundant pool of knowledge generated by the technical and institutional community.

The project's symbiotic relationship with the ECBC is further reinforced through the Project's deliberate effort to build on top of the ECBC programme's existing knowledge assets that have been put into the public domain thus avoiding duplication of effort and improving efficiency of resource allocation.

III. 3.5 - Integrating Technologies

Technology Adoption Programme

This project addresses Voluntary Technology Adopters that are persuaded through providing a decision support system and efficiency eco-system creation in the form zero-cost technical feasibility studies, network building with vetted green building architects (proficient with building envelope efficiency and passive cooling design), sustainable cooling technology providers in India, and bridge-building services through workshops and roundtables to catalyse uptake of design concepts and technologies to reduce cooling related energy consumption and GHG emissions. These studies include building energy simulation modelling and life-cycle energy, cost, and GHG emission benefits for a key building (existing or panned) in their property portfolio.

Voluntary Adopters sign MoUs with the Program that declare their willingness to provide all the necessary building design data that can enable development of energy efficient building design combined with sustainable cooling scenarios and their presentation in the form of a Technical Feasibility Study for retrofit or new building projects. Through the MoUs they also pledge to procure sustainable cooling technologies for meeting their cooling requirements wherever technically and commercially feasible.

The primary active cooling technologies that will be addressed as part of this Project are outlined below.

Natural Refrigerant uptake for ACs: This is a low-hanging fruit intervention available to increase efficiency in air conditioning in India. Best-in-class ACs in terms of the refrigerant gas used and the level of Energy Efficiency will be promoted as the first option when shopping for an AC. Natural refrigerant split-unit ACs that use natural refrigerants (R290 being one of the most viable options amongst them) are available on the Indian market as a world première . These ACs are now being commercially manufactured in India and China, but their share of the annual sales volume of ACs is negligible. R290 split-unit ACs are not only far more energy-efficient (20% more compared to conventional split-unit ACs), but lead to lower GHG emissions from fluorinated refrigerant leakage. In 2005, such leakages were responsible for 17% of direct global warming. Research studies have concluded that if global efforts to reduce GHG emissions succeeded in limiting global warming to below 2°C but did not influence HFCs, these would be responsible for 28% to 45% of GHG emissions by 2050.

Natural refrigerant uptake in centrally-cooled buildings: A vital new dimension of the R290 refrigerant application is the use of R290 as the primary refrigerant in centrally-cooled commercial buildings that use water or other heat transfer fluids in a secondary cooling circuit. R290 successfully competes with conventional high-GWP refrigerants in a much larger share of the conditioned space in developing economies than is currently possible with a split-unit AC focus. Fairconditioning will create opportunities for technology transfer and knowledge-sharing amongst leading manufacturers and designers of R290 air conditioning systems for commercial buildings in Europe (UK, Ireland, Germany, Denmark) and HVAC experts and consultants in India; this will lead to the development of Pilot installations for different types of commercial buildings: hotels, corporate offices, administrations, malls, supermarkets...

Evaporative Cooling uptake: The lowest annual energy consumption and GHG emissions per unit area of cooled space in hot and dry and hot and humid regions is achieved through the use of evaporative cooling as opposed to the business-as-usual options of unit ACs or central AC systems. However, due to a variety of factors (lack of awareness, overwhelming influence exerted by HVAC consultants who favour vapour compression refrigeration (VCR) systems), the uptake of this alternative is significantly lower than should otherwise be the case given its immense potential for cost and energy conservation for end-users. Fairconditioning will include awareness creation amongst HVAC consultants and facilitation

of evaporative cooling technology through the same channels as those devised for R290 uptake, further explained below.

According to a study from the American Council for an Energy-Efficient Economy, greywater can provide 40-100% of the required 200 to 650 L/household/day based on conservative cooling load calculations. This research showed that in different regions of the world where water scarcity is a critical factor, Energy Efficiency and economic benefits substantially outweigh the costs. Newer evaporative air cooling technologies such as Indirect Evaporative Cooling use 30% less water than conventional air coolers.

Passive (Structure) and Active Radiant Cooling: Active and Passive Radiant Cooling is based on the physical principle, that bodies with varying temperatures exchange thermal radiation until an equilibrium is achieved. Thus, unlike conventional HVAC systems which directly exchange heat with occupants through the medium of air, Radiant Cooling systems rely upon the cooling effect achieved when occupants spontaneously emit heat from their bodies when placed in an environment where the ambient wall, ceiling or floor temperature is less than the average human body temperature (i.e. 370C). The principle of Radiant Cooling is ubiquitous in a significant number of historical buildings where naturally cooled water (from a ground or surface water source) is circulated through ceilings or floors by means of a simple plumbing system consisting of pipes, channels etc. This type of cooling system is largely effective in absorbing and 'draining' solar energy gained by the building structure and partially useful for addressing other cooling loads such as internal sources of heat, humidity from occupants etc. The project seeks to promote mainstream application of this cooling principle through promoting pilot installations of commercially available but non-mainstream technologies in buildings amongst the economic sectors of interest. Even in conditions where the technology cannot entirely replace conventional HVAC systems due to its inability to dehumidify air (e.g. humid regions where humidity must be controlled), it has the potential to greatly reduce compressor sizes and associated air handling system unit sizes. The consequent impacts are reduced direct GHG emissions (stemming from lesser mass of refrigerant charge and associated leakage) and indirect GHG emissions due to reduced electricity usage from smaller compressors. Energy and GHG savings from this technology are expected to be in the range of 30% depending on the specific kind of system used and the climatic conditions where the building is situated.

Solar Vapour Absorption Machines: Vapour Absorption chiller machines (VAM) produce chilled water using a heat source rather than electrical input as in the case of vapour compression cycle. While an electric chiller employs a mechanical compressor creating the pressure difference necessary to circulate the refrigerants, an absorption chiller uses a heat source to drive the refrigeration system and a secondary fluid or absorbent to circulate the refrigerant. The difference causes an absorption system to use little to no electrical work input but instead requires heat input. This makes the system an attractive option when there is a renewable and clean source of heat, such as solar heat or waste heat from fossil fuel combustion. This technology yields a plethora of environmental and economic benefits; the primary being drastically reduced electricity consumption (power requirement for operating pumps) related to Vapour Compression systems, and avoidance of HCFC or HFC refrigerants. However, the substantial space requirements for cooling towers, and solar heat harvesting makes it suitable for large applications only. The project will promote this technology in non-residential applications where sufficient space for mounting solar panels and access to adequate solar heat is available.

Passive Cooling Technologies: Besides the above active cooling technologies, the project will also promote passive cooling technologies and design approaches in buildings. The more prominent amongst these are: Roof and Wall-Insulation, Radiant Barriers / Night-Sky Radiation Systems that shield roofs from solar radiation during the daytime and promote rapid heat dissipation through radiation into the cool night sky at night using retractable low-emissivity radiant barriers and high-emissivity roof coatings, Efficient Fenestration Systems such as Engineered Glazing and Double-Glazed Units, Shading Devices, and Spectrally Selective Window Films.

III. 3.6 - International Networking and Advocacy

The Fairconditioning programme is incubating a culture of Energy Efficiency in the indoor thermal comfort sector well beyond the urban centres where

the programme originates. The successful uptake of Energy Efficient techniques and behaviour in the fastest growing Indian cities creates vectors for change in other high growth regions.

The Fairconditioning management team contributes to regional and global fora dedicated to improving Energy Efficiency in the cooling sector through the use of natural refrigerants and participates in Montreal Protocol working groups.

Fairconditioning is dedicated to disseminating evidence-based information on low energy indoor cooling through natural refrigerants. Its expert team publishes articles for the specialised press and builds partnerships amongst industry, energy experts and consultants, civil society, and academics to promote awareness of and support for low energy indoor cooling techniques and consumer behaviour.

V. Fairconditioning Legacy Programme

Grounding Energy-Efficiency in graduates

Fairconditioning's curricula change programme ensures that students graduating from engineering and architecture institutes in 8 leading cities will have been sensitised to the larger goal of cooling interiors using the most energy-efficient technology and design available. Starting in the second year of Fairconditioning in 2015, for each of the 8 urban centres, an average of 50 engineering students and 50 architecture students will have their curricula upgraded to include Energy Efficiency. It would be presumptuous to try to estimate the amount of energy saved by the Fairconditioning programme. However, there will be a lasting ripple effect in the quality of education for architects and engineers and the broad scale implementation of this new skill set on the ground. Fairconditioning is building sustainable people skills. India is rapidly developing a highly-competitive, consumer-orientated free market economy, and individuals are seeking educational opportunities to support a sense of purpose to their professional life. Fairconditioning is bringing opportunity to students and young professionals to take a proactive role in reducing India's carbon intensive GDP growth and in supporting sustainable development and sound energy policies.

Creation of India's First Open Access Web-based Sustainability Mapping Platform

Fairconditioning is developing an internet-based tool to map the sustainability efforts of various businesses, communities and individuals in India with open source geographical information systems (GIS). This tool enables users to view, understand, interpret, and visualise sustainability efforts quantitatively & qualitatively to reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. The tool creates a platform that takes data on sustainability performance related to homes, buildings, neighbourhoods, commercial establishments and campuses (educational, corporate, institutional...) submitted by individuals, research institutes, civil society organisations and companies. All data will be made available for download through interactive features by selection of geographical boundaries, data types, and specific organisational units (buildings, hotels, IT offices) for use by civil society organisations, research institutions and policy advocacy groups.
The GIS platform's data-points will contain exhaustive up-to-date information related to sustainability metrics with supporting documentation such as descriptions of technological, behavioural and operational processes/policies adopted to enhance sustainability performance, videos, sustainability reports, images related to sustainability initiatives, GHG mitigation (tonnes CO2e avoided/year), energy conservation (kWh and kJ avoided/year), water conservation (kilolitres avoided per year), community socio-economic and environmental development project metrics, etc.

Comparisons of sustainability performance will be made available through statistical analysis, tabulation, and plots/charts that can be accessed for real-time visualisation and download. This tool will support policy advocacy by enabling visualisation of sound data in trends and will assist in quantifying opportunities for GHG mitigation, energy conservation, water intensity reduction, etc. in geographical regions and economic sectors of India. A bulletin board forum and dynamic library of learning materials for exchanging sustainability best practices for all vital economic sectors will be set up and embedded into the platform. Empowerment of specialised sustainability efforts by

other groups will be supported by the publication of content onto other platforms through Application Programming Interface (API) and other facilities for embedding GIS maps / widgets onto other portals, mobile communication platforms, etc.

Fairconditioning portal

Fairconditioning will establish a network of technical consultants, HVAC professionals, and architects working with academic research assistants to offer free, or subsidised low-cost energy modelling services to SMEs.

Academic Curricula Integration

Students graduating from institutes and universities where Fairconditioning is an integral part of the curriculum will have worked on the integration of Green building codes and Energy Efficiency know-how. This knowledge will become a vital asset in building efficient homes and buildings.

International Technical Cooperation

The Fairconditioning programme goes beyond a focus on room ACs (focus of the Pilot programme) and, for the first time in India, creates an International knowledge transfer and technology exchange related to Natural Refrigerant AC technology for centrally-air conditioned buildings. The programme involves direct contact between the Natural Refrigerant AC technology fraternity in Europe and USA that has been instrumental in designing and constructing centralised chiller-based AC systems using Natural Refrigerants and the Indian AC technology fraternity, with the goal of establishing the first prototype for Naturally Air Conditioned Commercial Building in India.

Official recognition for Natural Refrigerant ACs in India's Sustainable Building education and implementation initiatives

The Fairconditioning programme will embed educational content related to the Energy Conservation Building Code of India and Natural Refrigerant AC technology into the curricula of privately operated and semi-governmental Engineering universities and Architecture colleges of India. This will continue to have a lasting impact beyond the time horizon of this project. Fairconditioning will engage with the Indian Green Building Council, the TERI GRIHA rating systems, and sustainable building initiatives in order to recognise the role of Natural Refrigerants in reducing GHG emissions from India's buildings. This will be done by encouraging formal inclusion of appropriate criteria into their respective rating systems for Sustainable Habitats.

Assets and Tools for Catalysing Sustainable Cooling Technology Adoption

- Upgrading of Industry-Standard Building Heat Load and HVAC Modelling Softwares (developed by Industry Associations) to include Sustainable Cooling Technology modelling options to replicate the ease and sophistication available for modelling conventional HVAC systems.
- Development of rigorously vetted Technology Adoption Process Flow that guides the engagement process with commercial enterprises from initial contact / sensitization to eventual technology adoption
- Compilations of technical dossiers for all relevant alternative cooling technologies available in India including technical specifications, site installations or commercial references, and updated capital cost data.
- Creation of preliminary and detail building/site level data collection questionnaires for overall building heat load estimation and high-level alternative cooling technology scenario modelling to arrive at energy, life-cycle cost, and GHG savings scenarios relative to Business-as-Usual conditions
- Development of Memorandum-of-Understanding (MOU) formats in consultation with Corporate Lawyers to ensure clear and unambiguous articulation of contract terms and conditions that define the services available and corresponding commitment requirements from beneficiaries through the Fairconditioning Program to potential Voluntary Technology Adopters from the aforementioned economic sectors : Hotels, Banks, Real-Estate, and IT/BPO companies.
- Creation of a Marginal Abatement Cost Curve tool to compare life-cycle GHG mitigation benefits per INR (Rupee) of life-cycle cost (capital and operating costs) of competing conventional and alternative cooling technologies.
- Establishment of a standardized Technology Feasibility Report format to convey Building and Sustainable Cooling technology modelling

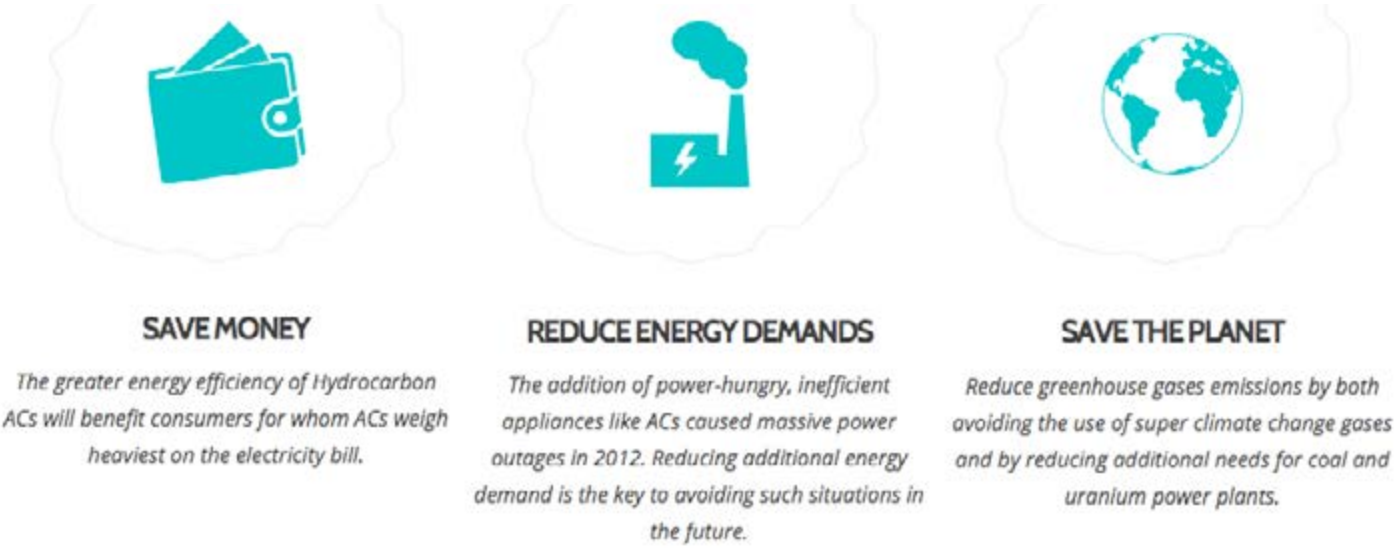
results (output from modelling softwares as well as custom-built spreadsheet tools), technical parameters, costs, and other advantages and disadvantages (operation and maintenance requirements etc.) of filtered set of technology options for a Program beneficiary (i.e. Voluntary Technology Adopter).

Teaching Materials and Aids

The Academic Curricula Integration Project will lead to creation of Online Courses (MOOCs) related to Building Physics, Passive Design Strategies, and Sustainable Cooling Technologies available on publicly accessible platforms at no cost to professors, students, and practitioners of Architecture and Mechanical/Civil Engineering. Additionally, Physical Models and other teaching aids to promote tactile and visual understanding of these concepts will be created and made physically available to colleges in each program city beyond the program time frame.

Professional Certification Courses

In conjunction with ISHRAE, the program seeks to create vestly expanded versions of the 5-day student certification programs as a continuing education certification courses available to fresh graduates or practicing HVAC engineers to deeply embed Sustainable Cooling Technology Design capacity and capability in the industry. These courses will be accessible perpetually beyond the program time frame through the well established training and capacity building structures created by ISHRAE across India and offered to paying members through city chapters.



V. Fairconditioning Partners

V. 1 - Consumer Ambassadors

- **The Consumer Education & Research Centre (CERC)** is the leading consumer rights organisation in India. CERC helps to organise awareness programmes by conducting conferences, campaigns etc. They can promote the technology on ENVIS i.e. the Environment Information System portal and also publish it in their newsletters. The CERC is a semi governmental body receiving public funding.

- **The Alliance for an Energy Efficient Economy (AEEE)** is a not-for-profit industry association created for the specific purpose of facilitating collaboration among India's Energy-Efficiency industries and service providers. AEEE plan to contribute by mentoring a pilot scale ESCO operation model with Godrej to test its feasibility. Furthermore, AEEE is also keen delve into advocacy with Godrej for a utility-scale subsidy or finance programme

- **The Council on Energy, Environment and Water (CEEW)** is an independent, not-for-profit policy research institution. CEEW addresses pressing global challenges through research, partnerships with public and private institutions. CEEW has been rated as India's top climate change think-tank in 2012 and 2013 as per the ICCG Climate Think Tank's standardised rankings.

- **The Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE)** has more than 10,000 HVAC&R professionals and 3,000 students as members with 40 chapters and sub chapters across India. ISHRAE's primary objective is the advancement of the art and sciences of Heating, Ventilation, Air Conditioning, Refrigeration Engineering & other related Building Services.

- **The Center for Study of Science, Technology and Policy (CSTEP)** is an Indian not-for-profit research organisation. As one of the largest Think Tanks in South Asia, its vision is to enrich the nation with technology-enabled policy options for equitable growth in the areas of Energy, Infrastructure, Security Studies, Materials, Climate Studies and Governance.

- **The Confederation of Real Estate Developers' Associations of India (CREDAI)** is the apex body for private Real Estate developers in India. It has 11500 Members through 23 State Chapters and 154 City Chapters. CREDAI is also a knowledge-sharing forum for the latest industry data, technology advancements, industry benchmarks and international situation

- **The National Association of Software and Services Companies (NASSCOM)** is a trade association of Indian Information Technology (IT) and Business Process Outsourcing (BPO) industry. Nasscom helps set strategic direction for industry policy advocacy for industry growth. Nasscom is active in workforce development also in the field of sustainability.

- **The Indian Institute of Architects (IIA)**, the national body of architects. The Institute plays a major role in promoting the profession of architecture by organising and uniting in fellowship the Architects of India. IIA promotes aesthetic, scientific and practical efficiency of the profession both in Practice and in Education.

V. 2 - Technology Ambassadors

- **Schneider Electric India Pvt. Ltd.** is a subsidiary of Schneider Electric Industries SAS, a global specialist in energy management.

- **Enervision** is an energy management service provider helping its clients to reduce energy bills through Energy-Efficiency gains.

- **Pradeep Sachdeva Design Associates** is a design studio in New Delhi. Their portfolio encompasses Architecture, Urban Design, with a focus on public places and the hospitality industry.

- **VISION Electro Mechanical Consultants** is an engineering firm that undertakes consultancy assignments and provides expert technical services in the HVAC field.

- **Vision PowerfactX** renders services in technical consultancy, audits and troubleshooting assignments. Their services include energy audit, renewable energy solution consultancy and thermal imaging.

V. 3 - Academic Ambassadors

- **Rachana Sansad Institute of Environmental Architecture (RSIEA)** is a constituent of 'Rachana Sansad', a public trust registered under the provision of Bombay Public Trust Act 1950. RSIEA takes on environment and architectural design related research & development projects. They are Fairconditioning partner in conducting Train the Trainer programmes for practicing architects and professors in fourth year from architecture colleges in Maharashtra.

- **Maharashtra Institute of Technology, Pune (MIT Pune)** established in 1983, is amongst the top engineering colleges in India. MIT is affiliated to the University of Pune. They have partnered to develop and conduct Fairconditioning certificate courses for Mechanical Engineering students to stimulate the interest of students for energy efficient cooling technologies, natural refrigerants and advancing knowledge related to Energy.

- **Kamla Raheja Vidhyanidhi Institute of Architecture and Environmental Studies, Mumbai (KRVIA)** is one of the premier institute in the field of architecture in Mumbai. It offers a Bachelor in Architecture degree (B. Arch) and two full time Masters courses (M.Arch – Urban Design/ Urban Conservation). All of these courses are run under the aegis of the University of Mumbai.

- **MES College of Engineering MES College of Engineering, Pune (MESCOE)** is one of the most reputed institutes offering Engineering courses at the undergraduate and graduate level in the country. This Institute has state-of-art facilities in the field of engineering and concentrates on grooming motivated, self-esteemed, environment friendly and creative engineers.

- **School of Planning and Architecture, Delhi (SPA)** is a specialized University with Human habitat and environment as the basic concern of the School. The spectrum of academic programmes is being continuously extended by providing programmes in new fields and emerging areas.

VI. Fairconditioning Team

VI. 1 - Governance

The Fairconditioning programme is governed by an Executive Board, currently chaired by Mr Chaïm Nissim, Founder of Noé21. Fairconditioning is managed by expert staff in Geneva and Pune (State of Maharashtra) under the responsibility and supervision of the Programme Manager, Mr Philippe de Rougemont and India Programme Manager, Mr Vivek Gilani. Regular formalised coordination takes place between the Geneva-based and Pune-based teams for programme administration, finance, and development to ensure streamlined programme management and the attainment of programme goals and objectives. The Advisory Board members have a varied skill set and breadth of experience and serve as senior experts to the Executive Board and programme team.

Partner NGOs (Environmental Ashoka Fellows and Karmayog network) (see chapter IX, p. 28) are engaged in each of the 8 urban centres to coordinate Fairconditioning on the ground under the supervision of the India Programme Manager.

VI. 2 - Geneva office

- **Philippe de Rougemont**, Programme Manager
  Fairconditioning Executive Board member
  Political science, University of Geneva. Held several positions in local and national environmental NGOs. Freelance journalist. Co-founder of Noé21 and DATAS press agency, Noé21 Coordinator

- **Chaïm Nissim**, Executive Board Chairman, Engineer, Noé21 Founder
  Fairconditioning Executive Board member
  Dipl. in Information Technology and Electronics, Swiss Federal Institute of Technology. Various development posts at CERN and expertise in several nuclear magnetic resonance machines. Four term MP in the Geneva Canton parliament. Author of several laws on energy. Noé21 Secretary General.

- **Dr. Felix Dalang**, Scientific Adviser, Noé21
  Fairconditioning Executive Board member
  PhD in environmental chemistry, Swiss Federal Institute of Technology, and Swiss Federal Institute of Aquatic Science and Technology. Specialisation in indoor air quality control and energy policy.

- **Rédha Farah**, Back office IT Officer, GIS Specialist, Graphic designer
  Masters in Geology, complementary certification in geomatics, University of Geneva. Held several positions in local organisations and at the United Nations Institute for Training and Research (UNITAR). Co-founder of the Swiss Organisation for Research & Development (SWORD).

- **Anouk Zosso**, Accounting and Finance Officer
  Masters in Geology and Masters in Biogeoscience. Held several positions in local organisations.

- **Sven Schmitz-Leuffen**, Technical Advisor, GIS specialist.
  Consultant for mapping tools (GIS).

VI. 3 - Mumbai / Pune office

- **Vivek Gilani**, Fairconditioning Programme Manager for India.
  Fairconditioning Board member
  Managing Director, cBalance Solutions Hub
  Ashoka Fellow. Environmental Engineer (MS Environmental Engineering, University of Massachusetts) with expertise in Water, Wastewater Treatment and GHG Inventorying, and Energy Auditing/Analytics. Bureau of Energy Efficiency (India) Certified Energy Auditor. Co-founder of India's first Individual Carbon-Footprint-Calculation and Reduction movement - the NO2CO2 project at www.no2co2.in. Co-Founder and Member of the Steering Committee for the First Eco-labelling Programme in India – The Green Signal, Founder of the 'Informed Voter Project' (www.MumbaiVotes.com)

- **Saumya Aggarwal**, Programme Officer
  MBA in Energy Trading from University of Petroleum and Energy Studies (India). GHG Inventorying Analyst in the fields of Energy and Environment. Fairconditioning Pilot Phase Programme Coordinator for Voluntary Adopters, Technical and Academic Ambassadors.

- **Gyan Prakash**, Programme Officer
  MBA in Energy Trading from University of Petroleum and Energy Studies (India). Director of Eco-labelling Services at cBalance Solutions Pvt. Ltd. Dehradun. GHG Inventorying Consultant for Carbon ERP and Product Carbon Footprinting projects.

- **Bhagyesh Deo**, Programme Officer
  Computer Science Major (MS Computer Science, Pune University) and Post Graduate Diploma holder in Geographical Information System & Remote Sensing. Has gained GHG inventorying experience as a Consultant and Research Analyst in the fields of Energy and Environment.

- **Rajesh Rangarajan**, Project Manager
  A MS in Ecology and Environmental Sciences from Pondicherry University with 15 years of experience engaging in programmes and projects on environmental pollution and sustainability, coastal environment protection, climate change and environmental governance. He has been engaged as a consultant with UNDP, Exnora International and IFMR, Chennai (Institute for Financial Management and Research) working on range of environment projects. He also has management experience working as Project Manager for Post-Tsunami Environment Initiatives, a project of the UN Tsunami Recovery Support. He has authored/co-authored over thirteen research publications.

- **Kanika Mathur**, Research Analyst
  A B.Tech in Biotechnology and M.Tech (Sustainable Development and Climate Change) from CEPT University, Ahmedabad with internship work experiences at Center for Environment Education (CEE), Ahmedabad, Abellon Clean Energy and INMAS, Defence Research and Development Organization (DRDO), Delhi.

- **Udit Bansal**,
  MS Industrial Engineering Manufacturing, Georgia Institute of Technology. Consultant and Research Analyst in the fields of Energy and Environment. Core team member for analysing trends and designing a rating and benchmarking system for Energy-Efficiency of hotels and hospitals in India as part of the ECO3 Project with USAID.

VII. Fairconditioning Advisory Board

- **Nicholas Cox**, Independent expert on refrigerants, Earthcare Products Limited, Ware, UK

- **Dr. Félix Dalang**, Chemist, Scientific Advisor at Noé21, indoor air quality specialist, Geneva.

- **Aalok Deshmukh**, General Manager - Energy-Efficiency, Schneider Electric (India), Delhi. CMVP, LEED AP. Ex- Chief of Party USAID ECO-III Project, Ex- Technical Advisor to the Bureau of Energy Efficiency and to the Government of Gujarat. He has also been a part of the LEED certification review team and has served on the LEED NC Core Committee for the US Green Building Council.

- **Darshi Dhaliwal**, Proprietor, Toro Cooling Systems Pvt. Ltd. Mr. Dhaliwal develops innovative design & engineering cost effective solutions for low energy cooling in Industrial, commercial and domestic applications. Member of The Data Center Professionals Network. He has been leading teams of professionals to develop and market new efficient cooling products in India. Pune

- **Dr. Vishal Garg**, Associate Professor and Head, Center for IT in Building Science, International Institute of Information Technology Hyderabad (IIIT H). Has done his PhD in Energy Studies from IIT, Delhi. He has experience in Teaching, Research and Consulting in Green Buildings, Building Energy Simulation and Cool Roofs.

- **Brent Hoare**, Independent expert on refrigerants, Green Cooling Association INC, Katoomba, Australia

- **Dr. Ratnadip Joshi**, Associate Professor, Maharashtra Institute of Technology (Petroleum and Petrochemical Engineering). Executive Committee Member, IIChE Pune Regional Centre.

- **Dr. Ardeshir Mahdavi**, An university professor and Director of Department of Building Physics and Building Ecology and Director of Graduate Program in Building Science and Technology in Vienna University of Technology, Karlsplatz, Vienna - Austria

- **Nina Masson**, Head of Market Research & Projects, Shecco, Brussels

- **Janos Mate**, Ozone Policy Consultant at Greenpeace International, Vancouver, CA

- **Dr. Jyotimay Mathur,** Professor in Mechanical Engineering and presently the Head of Centre for Energy and Environment at Malaviya National Institute of Technology, Jaipur (India). He is a mechanical engineer, having done post graduation in energy studies from the Indian Institute of Technology, New Delhi (India) and doctorate in energy systems from University of Essen (Germany). He works in the field of energy planning and modelling, building energy codes, energy simulation, energy conservation in buildings and life cycle assessment of renewable energy systems. Current activities of him include studies on adaptive thermal comfort, energy simulation of buildings, modelling of passive cooling systems, long term energy system modelling penetration of renewable energy systems and building integrated renewable energy systems.

- **Bhaskar Natarajan**, Energy-Efficiency Expert, Ph.D Energy Management from Indian Institute of Management, Bangalore.

- **Rajendra Shende**, Independent expert on refrigerants, former UNEP Ozone Unit Head, TERRE Policy Centre, Pune

- **Mr. Sandeep Sonigra**, Director Orange Country Foundation, Pune

- **Fionnuala Walvarens**, Campaign Manager, Environmental Investigation Agency, London

- **Dr. Jyotimay Mathur,** Professor in Mechanical Engineering and presently the Head of Centre for Energy and Environment at Malaviya National Institute of Technology, Jaipur (India). He is a mechanical engineer, having done post graduation in energy studies from the Indian Institute of Technology, New Delhi (India) and doctorate in energy systems from University of Essen (Germany). He works in the field of energy planning and modeling, building energy codes, energy simulation, energy conservation in buildings and life cycle assessment of renewable energy systems. Current activities of him include studies on adaptive thermal comfort, energy simulation of buildings, modeling of passive cooling systems, long term energy system modeling penetration of renewable energy systems and building integrated renewable energy systems.

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- **Fionnuala Walvarens**, Campaign Manager, Environmental Investigation Agency, London

VIII. Fairconditioning Deliverables

Quantifying net GHG emissions reductions and tracing them to a specific climate protection campaign would be presumptuous and easy to challenge. The climate campaign, either in favour of renewable energy production or Energy Efficiency is active with several programmes and policies initiated by governments, NGOs, and community-based initiatives. Fairconditioning relies on the implications of key market, academic, industry and consumer association stakeholders to instil a culture of Energy Efficiency. This and the upgrading of student curricula in strategic institutes will herald in the lasting legacy of Fairconditioning.

In addition to Mumbai and Pune where Fairconditioning Technology Ambassadors are already trained and operational, influential Ambassadors will be deployed in additional urban areas: Delhi (National Capital Territory), Kolkata (West Bengal), Chennai (Tamil Nadu), Bangalore (Karnataka), Ahmadabad (Gujarat), Hyderabad (Andhra Pradesh).

Each of these emblematic cities will have a living Energy Efficiency ecosystem incubated by the Fairconditioning team. This ecosystem comprises a network of a competent partner NGO, a leading architect, a major HVAC consultant, a hotel and bank branch executive and an engineering or architecture professor.
These individuals will decide to join as Fairconditioning Ambassadors following a 2-day technical training, motivated by contacts they are making with international experts, motivated by providing additional services to their partners and clients, and by a sense of belonging to an international industry community on the cutting edge of market evolution.

As from 2017, certified architects and engineers in the main institutes and universities of the above-mentioned States will have identified Energy Efficiency in refrigerants as a national priority and will be implementing this practical knowledge in their professional practices.

The reliable reputation of natural gas ACs will be firmly established amongst the many influential stakeholders in the vast refrigerant sector.

Evaporative cooling techniques will be recognised as the best solution for cooling in hot and dry and hot and humid climatic zones and will be promoted by credible professionals in the refrigerant sector.

In addition to the above articulated 'Legacy' of the Fairconditioning programme, a vital tangible legacy is the transformation in the resource mindedness and environmental sensitivity of various intervention groups addressed by the Vehicles for transformation: academics, students, business executives, builders, and technical experts. The programme aims to augment the culture of energy and carbon efficiency in India. It seeks to catalyse a change in culture through adding to the conversational lexicon (professional and otherwise), and concepts in the target communities – e.g. beginning-of-pipe vs. end-of-pipe, air conditioning vs. indoor thermal comfort, energy-use versus energy-access, energy rights vs. energy privilege... This is not a quantifiable accomplishment but an integral part of the Fairconditioning concept and its underlying motivation and broader goal.

VIII. 1 - Timeline

Intervention Programmes	2014	2015	2016	2017 and beyond
Upby2	Press conference to kick off campaigns Kick off campaigns in 4 colleges in each of the 4 Tier '1' cities (Mumbai, Delhi, Chennai, Kolkata)	Kick off campaigns in 4 colleges in each of the 4 Tier '2' cities (Ahmadabad, Hyderabad, Pune, Bangalore) Awards for Tier '1' cities campaign	Awards for Tier '2' cities campaigns	Handover of campaigns to local NGOs in 8 cities
Corporate Thermal Comfort Policy	Establishment of Corporate Advocacy Panel Kick off workshop with Corporates in Tier '1' cities	Kick off workshop with Corporates in Tier '2' cities	Final programme status report generation Workshop with Industry bodies for corporate policy advocacy	Thermostat & Dress Code Policy integration into Corporate Policy at Industry Body level
Energy Modelling Advisory	Energy Modelling Software Training Seminar (2nd half of year) Roundtable with SME Industry bodies in Tier '1' cities	Energy Modelling Software Training Seminar (1st half of year) Roundtable with SME Industry bodies in Tier '2' cities		
Academic Curricula Integration	2 Training Programmes for architecture & engineering college teachers in Tier '1' cities (1st & 2nd half of year) Launch of certificate programme offering in 1 college in each Tier '1' city	2 Training programmes for architecture & engineering college teachers in Tier '1' cities (1st & 2nd half of year) Launch of certificate programme offering in 1 college in each Tier '2' city		Permanent Curricula inte-gration of Energy Conservation Building Code, Natural Refrigerant AC technology at university level in 4 States
Technology Adoption – R290 ACs & Evaporative Cooling	2 R290 Unitary AC & Evaporative cooling stakeholder engagement seminars in Tier '1' cities (1st & 2nd half of year) Pan-India R290 Centralised AC Tech-transfer workshops	2 R290 Unitary AC & Evaporative cooling stakeholder engagement seminars in Tier '1' cities (1st & 2nd half of year) Pan-India R290 Centralised AC Tech Pilot Installation workshop	Pan-India R290 Centralised AC Tech Pilot Installation workshop	Permanent R290 AC installations at 200 Bank branches, 20 residential developments, 10 Hotel Resorts, and 4 Commercial buildings

IX. Indian NGO partnerships

The Fairconditioning Programme 8-city operation will rely upon a hybrid strategy of central programme organisation and detailed design with Fairconditioning's Executive Board and Advisory Board members, together with field coordination and implementation achieved through city-level environmental NGO partners.

The Indian NGO network will be developed through close interaction with the Ashoka Fellows network in India (50 Environmental Ashoka Fellows and their respective NGOs), Karmayog (India's largest NGO network), the no2co2 Environmental Project, and associated NGO partners. The preliminary selection of 8 city-level NGO partners amongst which some confirmed partners as follows:

- Centre for Environment Research and Education (CERE) - www.cere-india.org
- Sustainability Initiatives - www.sustainability-initiatives.org
- Prayas - www.prayaspune.org
- Council of Scientific and Industrial Research - www.csir.res.in
- Ashoka Fellow NGO network:
  - Centre for Science and Environment (CSE) - www.cseindia.org
  - Parivatan - www.parivartan.org.in
  - The no2co2 Environmental Project - www.no2co2.in
  - ReapBenefit - reapbenefit.org
  - Selco Foundation - www.selcofoundation.org
  - Srishto Toxics Link - toxicslink.org
- Karmayog Network :
  - Centre for Development Education (CDE) - www.cdeindia.in
  - Centre for Environment Education (CEE) - www.ceeindia.org
- Applied Environmental Research Foundation - aerfindia.org
- Industrial Green Chemistry World - www.industrialgreenchem.com
- India Redefined - www.indiaredefined.org
- Eco Needs Foundation - econeeds.org
- Parisar - www.parisar.org
- C.P.R. Environmental Education Centre - www.cpreec.org
- Balipara Tract & Frontier Foundation - baliparafoundation.com
- Burhani Foundation - www.burhanifoundationindia.org

X. List of abbreviations

AC	Air Conditioner
AEEE	The Alliance for an Energy Efficient Economy
BEE	Indian Bureau of Energy Efficiency
COP	Annual Convention of the Parties to a UN Protocol.
CERC	The Indian Consumer Education & Research Centre
DSM	Demand Side Management (as opposed to production side management)
ECBC	Energy Conservation Building Code
EPI	Energy Performance Index
ESCO	Energy Service Company
F-gas	Fluorinated (synthetic) gas.
GHG	Greenhouse gas
GIS	Geographical Information Systems
GRIHA	Green Buildings Rating System India
Gt	Giga-tonne or 10^9 tonne
HCFC	HydroChloroFluoroCarbon
HFC	Hydrofluorocarbon
HVAC	Heating, Ventilation and Air Conditioning sector
IT	Information Technologies
LEED	Leadership in Energy and Environmental Design. North American green building standardisation code
MDG	UN Millennium Development Goals
MEP	Mechanical/Electrical/Plumbing services
NRDC	National Resources Defence Council, North American NGO
R290	Propane (a natural refrigerant)
SME	Small and Medium Enterprise
UNDP	UN Development Programme
UNEP	UN Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Attached files

About Us

Noé21 and cBalance have partnered in the creation of Fairconditioning to design and implement an accelerated plan to develop the uptake of Natural Refrigerant ACs in India. (2012-2013). The partnership is now implementing a three-year Fairconditioning Programme aiming to cool Indian interiors efficiently and sustainably (2014-2017).

Noé21, founded by swiss engineer, Chaïm Nissim, is a Geneva-based specialised NGO whose mission is to identify, evaluate and promote solutions to climate change. Noé21 is a member of the Swiss Alliance for Climate, the European Office of Environment and Climate Action Network Europe CAN-E. Noé21 is accredited to the United Nations Framework Convention on Climate Change (UNFCCC)

cBalance, founded by an Ashoka Fellow, is a knowledge-centric social enterprise that specialises in Tool Building and Strategy Development for integrating Carbon ERP into institutional processes and enabling measurable, reportable, and verifiable GHG Emissions, Energy, Water and Waste Mitigation. It is a Bureau of Energy Efficiency (BEE) Certified Energy Auditor, an empanelled GHG Consultant with 'The Green Signal' - India's first eco-labelling programme.

Noé21 is the french acronym for New Economic Orientation for the 21st Century
Independent NGO specialized in solutions to climate change

Member of
European Environmental Bureau EEB, Brussels
Climate Action Network-Europe CAN-E, Brussels
Climate Alliance (Switzerland), Zurich
Accredited NGO to the UNFCCC, Bonn

noé 21
économie, énergie et société

Quai Charles Page 19 - 1205 Geneva - Switzerland
Phone: +41 22 329 51 36 - www.noe21.org - info@noe21.org

Graphic design : Rédha Farah

सत्यमेव जयते

Ministry of Power
Government of India

I am very happy to express its approval for the upcoming Noé21 and TERRE project aimed at promoting the use of natural refrigerants in the air conditioning industry in India .India being a signatory to the Convention on Climate Change has taken up a number of programs to address climate change in India. We feel that the involvement of Noé21 and TERRE will add thinking value and increase international visibility for our joint efforts to address climate change. The Ministry of environment and forests, India supports this project as it addresses two important objectives of the Indian Government: Reducing greenhouse gas emissions and increasing energy efficiency.

The project also follows several principles set forth in the National Action Plan against Climate Change (NAPCC) in 2008 by the Prime Minister's Council on Climate Change, as it:

- Promotes a cost-effective strategy for end use Demand Side Management (principle #3)
- Deploys appropriate technologies for both adaptation and mitigation of greenhouse gas emissions (principle #4)
- Aims at opening a new market that promotes sustainable development (principle #5)
- And includes international cooperation and partnerships (principle #7)

Although the project doesn't aim directly at protecting the poor and vulnerable sections of society (principle #1) or at achieving national growth objectives (principle #2) it doesn't either go against these principles.

For these reasons, the Government of Maharashtra supports the principles and technical focus of this project proposal and welcomes it in India.

With warm regards and best wishes

Sushilkumar Shinde

Government of India, shram shakti Bhavan – Delhi,Ph: 011-237104111 Fax: 011-23017970

APOSTROPH

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APOSTROPH AG bestätigt, dass die vorliegende Übersetzung durch eine für diesen Inhalt fachkundige Person ausgeführt wurde.

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APOSTROPH AG

Philipp Meier
Geschäftsleiter
Chief Executive Officer
Directeur
Direttore
Director

Bescheinigung

„Der unterzeichnete Notar des Kantons Luzern bescheinigt hiermit, dass Herr Philipp Meier, geb. 10.11.1975, verheiratet, von Schneisingen (Aargau), wohnhaft in 8004 Zürich, Birmensdorferstrasse 15, die obenstehende Unterschrift ihm gegenüber als seine eigene Unterschrift anerkannt hat.

Herr Philipp Meier hat sich mit der Schweizer Identitätskarte Nr. C0336398 gegenüber dem Notar rechtsgenüglich ausgewiesen.

Certification

The undersigned Notary of the Canton of Lucerne hereby certifies that Mr Philipp Meier, born 10 November 1975, married, of Schneisingen (Aargau), residing at Birmensdorferstrasse 15, 8004 Zurich, has confirmed to him that the signature which appears above is his.

Mr Philipp Meier provided sufficient legal proof of his identity to the notary by producing Swiss identity card No. C0336398.

Luzern, 11. Oktober 2012

Ord. Nr. 2012/649

Der Notar

lic. iur. Marc Bloch
Notar des Kantons Luzern
Rechtsanwalt

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REPUBLIC AND CANTON OF GENEVA
Department of Finance
State Councillor

DF
P.O. Box 3860
1211 Geneva 3

N/ref. : 201595-2007 DH/DS

Association Noé 21
For the attention of Mr Haïm Nissim
Quai Charles Page 19
1205 Geneva

Geneva, 25 August 2008

Re: Request for tax exemption for Association Noé 21

Dear Sir,

In your application dated 10 July 2007, supplemented by your letter of May 26, 2008, you requested that the profit and the capital of the legal entities of the institution mentioned above should be exempted from income tax.

We have read the Articles of Association and documents produced by your institution, the purpose of which is "to set up a centre of expertise and action for solutions to the greenhouse effect, to spread and deepen knowledge about market instruments, in particular the ecological tax reform". This goal fulfils the legal requirements for a public utility.

Pursuant to Article 9, paragraph 1, letter f of the law on the taxation of legal entities of September 23, 1994 (hereinafter LIPM),

I inform you that:

The Association called Association Noé 21 is exempt, from the tax period 2007 (Fiscal Year ending in 2007) and for a duration of ten years, from taxes on income and capital as designated in LIPM.

This exemption does not extend to supplementary property tax or to the tax calculated on all real estate gains or profits resulting from the sale of property and assets.

Upon entry into force of the new law 9863, the exemption shall extend to supplementary property tax on buildings directly used for social purposes, to the rights of succession within the institution of

heirs, to legacies and other gifts in contemplation of death as well as to the registration rights on donations.

The Finance Department expressly reserves the right to review at any time the tax exemption granted especially when the conditions that gave rise to it are no longer fulfilled.

Any changes to the Articles of Association or business which the association actually carries must be brought to the attention of the Department of Finance.

As the association is subject to the LIPM, the law on public contributions of 9 November 1887 and the Tax Procedure Law of 4 October 2001 (hereinafter LPFisc), it must satisfy in particular, under the law, its tax reporting obligations and other procedural requirements.

At the expiry of the validity of this decision, the association can submit an application for the renewal thereof.

Within the meaning of section IV LPFisc, a complaint against this decision may be filed within 30 days of its notification with the Department of Finance, 26 rue du Stand, P.O. Box 3937, 1211 Geneva 3.

With best wishes.

(signature)

David Hiler

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